WATER WATER

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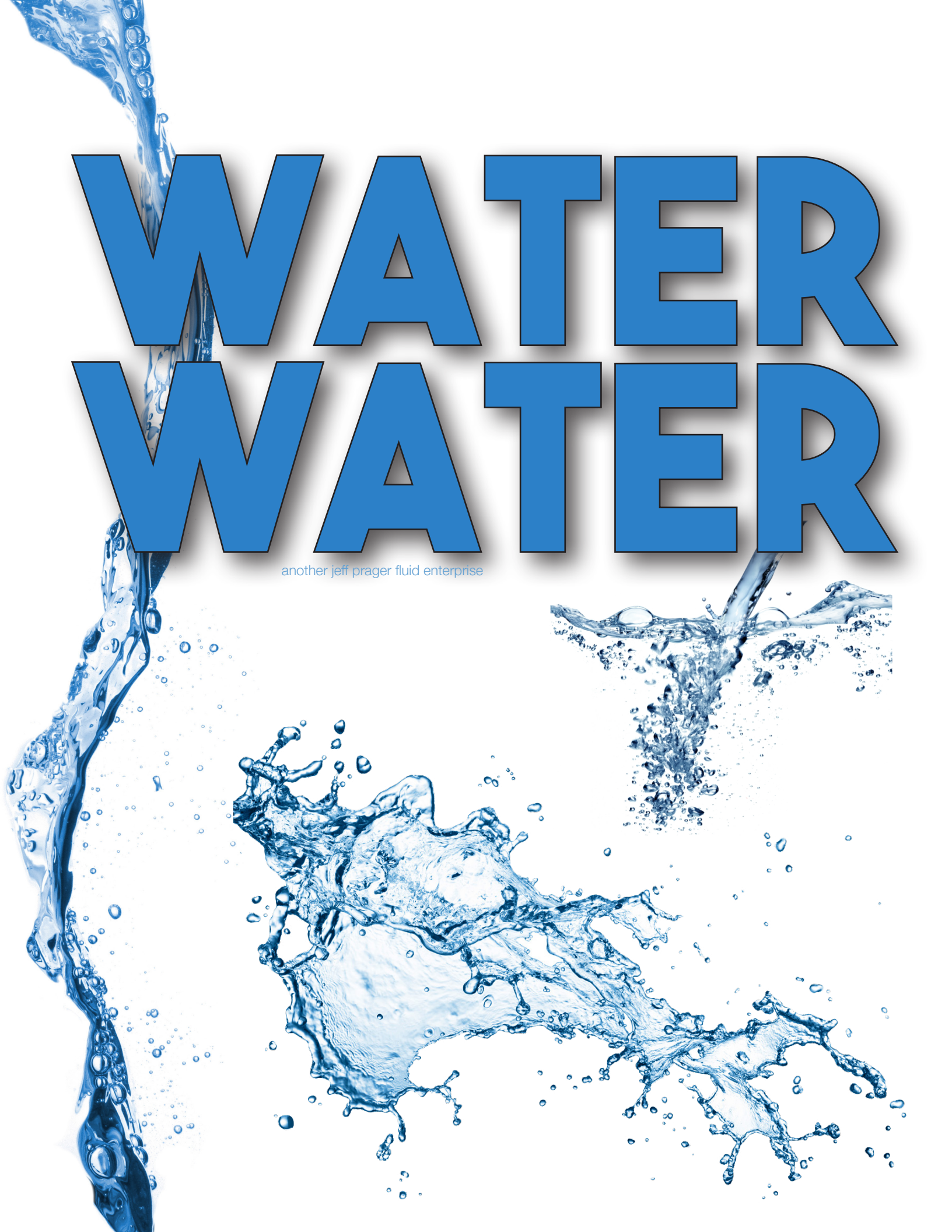

Journal of Epidemiology and Community Health
February 24, 2015

Are fluoride levels in drinking water associated with hypothyroidism prevalence in England? A large observational study of GP practice data and fluoride levels in drinking water

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Author information

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Abstract

Background: While previous research has suggested that there is an association between fluoride ingestion and the incidence of hypothyroidism, few population level studies have been undertaken. In England, approximately 10% of the population live in areas with community fluoridation schemes and hypothyroidism prevalence can be assessed from general practice data. This observational study examines the association between levels of fluoride in water supplies with practice level hypothyroidism prevalence.

Methodology

We used a cross-sectional study design using secondary data to develop binary logistic regression models of predictive factors for hypothyroidism prevalence at practice level using 2012 data on fluoride levels in drinking water, 2012/2013 Quality and Outcomes Framework (QOF) diagnosed hypothyroidism prevalence data, 2013 General Practitioner registered patient numbers and 2012 practice level Index of Multiple Deprivation scores.

Findings

We found that higher levels of fluoride in drinking water provide a useful contribution for predicting prevalence of hypothyroidism. We found that practices located in the West Midlands (a wholly fluoridated area) are nearly twice as likely to report high hypothyroidism prevalence in comparison to Greater Manchester (non-fluoridated area).

Interpretation

In many areas of the world, hypothyroidism is a major health concern and in addition to other factors-such as iodine deficiency-fluoride exposure should be considered as a contributing factor. The findings of the study raise particular concerns about the validity of community fluoridation as a safe public health measure.

In many areas of the world hypothyroidism is a major health concern and fluoride exposure should be considered as a contributing factor. The findings of this 2015 study raise particular concerns about the validity of community fluoridation as a safe public health measure.

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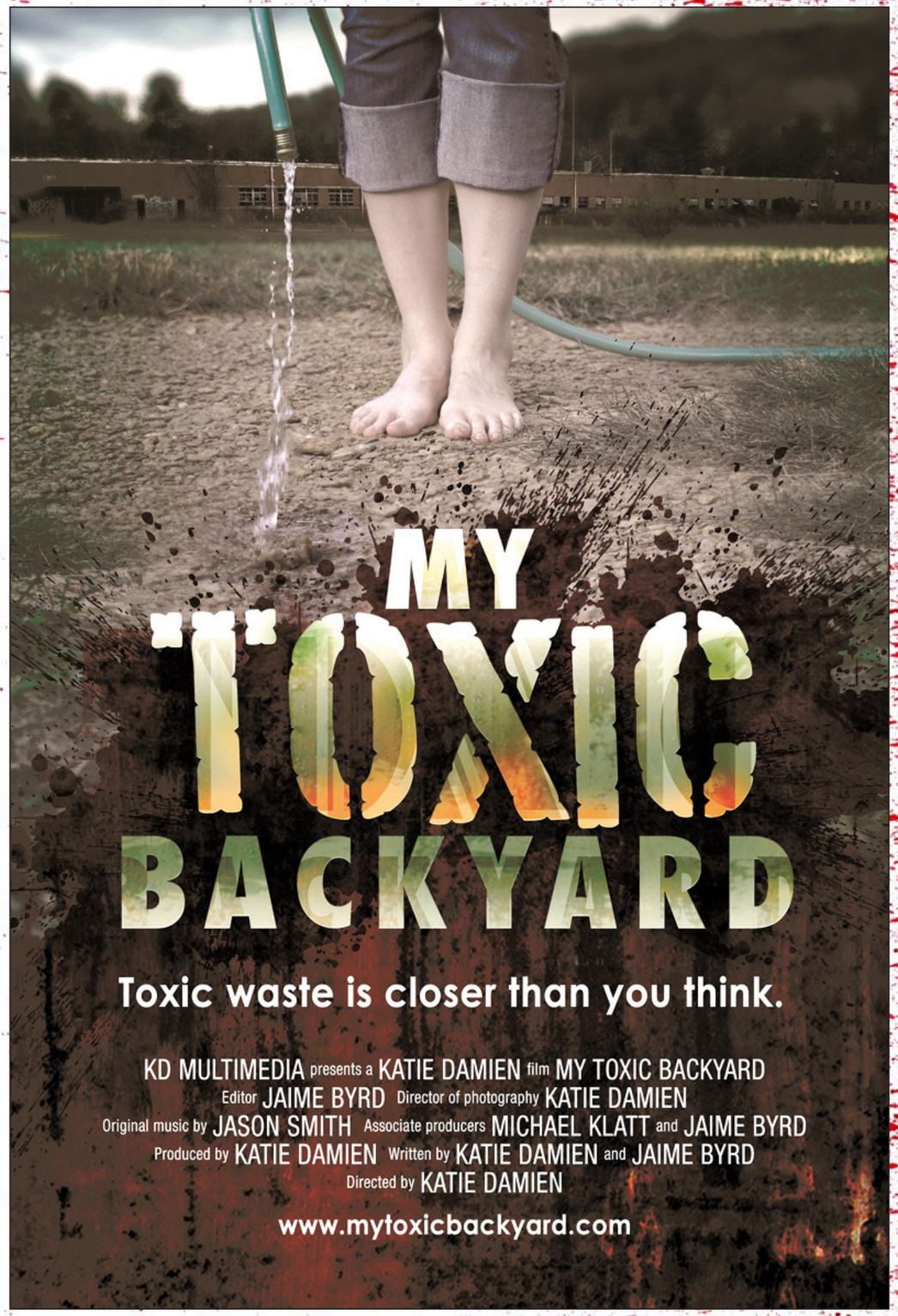
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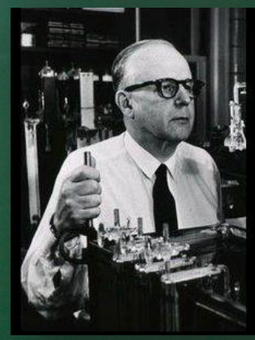


"In point of fact, fluoride causes more human cancer death, and causes it faster than any other chemical."

Dr. Dean Burk PHD
(34 years at the national cancer institute)

The Problem With Fluoridated Tap Water

by Jeff Prager

There's no way to measure your total daily fluoride intake. If, for example, you cook a meal of pasta with meatballs, include a fresh salad with a glass of juice, wine or soda and then have a piece of fruit afterwards, how much fluoride did you take in exactly? Then add the fluoride you consume brushing your teeth twice a day—and fluoride is far more dangerous to the developing brains of small children as you'll soon see—and you have no way of knowing how much fluoride you've consumed.

Fluoride is bioaccumulative. If we could simply urinate or defecate consumed fluoride out of our bodies every day we could all be eating fluoride candy bars without ill effects. That's simply not the case. Your body collects and stores fluoride molecules in a variety of organs including the brain.

Several peer reviewed reports included in this eMagazine indicate that children between 2 and 4 years old consume somewhere between 57% and 104% of the daily maximum allowable fluoride intake as recommended by the Institute of Medicines 1997 report titled "Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride," by simply brushing their teeth twice a day.

In the meal I described above, organic or not, the vegetables and fruits we consumed all contain trace amounts of fluoride. The pasta we cooked was boiled in fluoridated water and heat concentrates the fluoride. The meatballs were made with beef that was fed fluoridated water throughout it's lifetime and the soda, wine or juice are all created with fluoridated water. So how much fluoride did we consume? Of course we don't know.

Unfortunately the peer reviewed literature you'll be reading herein makes a clear case that any amount of fluoride is dangerous and damaging to the neurological development of children—while they're still in the womb and until they've reached 21 years of age or older—and that fluoride alone, but especially with other a significant reduction in cognitive function, intelligence other things.

In fact, after the age of 12 fluoridated drinking water can cause dental fluorosis, the precise disease that fluoridated water is alleged to control. There are so many problems related to fluoridated tap water that it's still amazing to me that it's a common and accepted practice.

There's trace amounts of fluoride in the air we breathe and there are trace amounts of fluoride in the foods we eat and there are trace amounts of fluoride in our water, placed there purposely. Added together, we all consume fluoride on a daily basis and we haven't the foggiest notion just how much we take in. A long-distance runner might drink 6-8 glasses of water a day. An infant on formula might also be drinking a significant and harmful amount of fluoride. There's simply no way to know.

The CDC web site states: "*all residents of a community can enjoy fluoride's protective benefits just by drinking tap water and consuming foods and beverages prepared with it*," just as I stated here in this preface.

That's the impetus for this eMagazine. While these are fun for me to create and even though my audience is quite small, it's important to me that those of you that care enough to download my free PDFs have the data necessary to understand this topic clearly and to debate this issue properly—with accepted peer review. No one can argue with peer review and frankly, no one ever does. It would be foolish to do so. This eMagazine is filled with links to well over 200 uncontested, published, peer reviewed reports and studies, with links, that assess the severe and harmful effects of fluoride on the human body and that cover the subject fully. Many of the linked reports and studies are dated this year, 2015. This is because I took the time to search them out so that you don't have to.

Ann and I eat a 100% organic diet and thus we completely avoid food additives, genetically modified ingredients and of course our glyphosate intake is substantially lower than those eating a regular American diet. We even use an organic toothpaste and in fact all of our cosmetic items like soap and shampoo are organic yet we still can't avoid fluoride completely because organic food regulations in the U.S. don't address fluoridated water. Since fluoridated water is often used to grow everything from collard greens to apples, it's just impossible to avoid fluoride.

The reports and studies herein are primarily from China, ther countries but there are also reports included here from d U.S. institutions. I truly love and respect all of my friends pe this eMagazine is helpful to those of you that download it. I learned a lot by researching and reading the material and I hope you do too. With this PDF you have everything you need in one place and no longer need to search across dozens of web sites to find the data you're looking for. Everything fluoride is right here. Remember, don't drink their water, don't eat their food and don't buy their stuff.

Water, Water, Everywhere
Yet None Of Our Water Is Clean

Our water contains measurable quantities of drugs like heart medications, psychiatric medications, anti-psychotics, antibiotics, pesticides, fungicides, herbicides and parts per million of the majority of the 10,000+ mostly untested chemicals manufactured in the USA. Some of these molecules are so small that we can't filter them out even with the most refined and expensive filtering system.

In 1945, Grand Rapids, Michigan became the first US city to fluoridate the public water supply. The idea quickly caught on, and the controversy began soon after: in growing numbers, a vocal minority has raised concerns about fluoride's role in a broad range of health problems. Fluoridation critics suggest fluoride exposure may be implicated in physical symptoms spanning gastrointestinal problems, low fertility, thyroid disease, endocrine disruption, arthritis, and cancer. Government health advisors disagree, arguing the benefits to developing teeth outweigh any established risks. Irrefutable evidence is hard to come by, due to the nature of the debate: in all major public health research, so many factors overlap that it can be impossible to either prove or disprove a condition's cause. And a controlled study (deliberately administering high doses of fluoride on selected humans for decades) would of course be unethical.

Recently, however, Harvard researchers were able to study health data for communities in China where high levels of fluoride are naturally present in the groundwater. Many of those Chinese peer reviewd reports will be found here in this PDF. The results give cause for unease: "*the children living in high-fluoride areas had significantly lower IQ scores than those who lived in low-fluoride areas*." The average difference was 7 points, and researcher Philippe Grandjean concluded that fluoride belongs among lead, mercury, and other poisons as a known neurotoxin and "*chemical brain drain*." Grandjean suggested that the developing brain may be irreversibly damaged by fluoride exposure, and the exact "*safe*" thresholds, if any, are unknown. Some of Philippe Grandjean's studies are here as well.

More and more of us are ready to opt out of fluoridation. But how can we take out these minuscule, tasteless molecules added at the treatment plant? If you're serious about going fluoride-free, here are a few things to consider.

What Doesn't Reduce Fluoride Exposure

The most popular water filters—the inexpensive activated-carbon pitchers and tap-attachments sold under the brand names Brita and Pur—can't remove fluoride. Boiling your water won't help, as the fluoride does not evaporate easily like chlorine; as the volume of water decreases through boiling, the fluoride concentration actually goes up.

Be aware that black and green tea as well as rooibos or "*red tea*" all contain high levels of natural fluoride; these beverages also provide beneficial antioxidants, but if you're concerned that your overall fluoride intake may be excessive, consider reducing your tea consumption. Processed beverages and foods, non-stick cookware, some pharmaceuticals, non-organic grape juice and wine, and of course fluoride toothpaste will all increase your overall fluoride consumption.

Berkey Water Purification System with PF2 Fluoride Filter

Low-tech: attractive countertop unit needs no hookups to plumbing or electrical systems. Filters can be cleaned and reused for maximizing sustainability and cost-effectiveness. Portable, can be used in the kitchen or off-grid to filter untreated water such as ponds and streams. Broad-spectrum, gravity-fed micro-porous filtration removes pathogens, volatile organic compounds, synthetic organic chemicals, MTBE, arsenic, heavy metals, and physical contaminants from water. This unit is our favorite because of its versatility, earth-friendliness, and overall effectiveness. Note that the optional PF2 fluoride filter must be added for fluoride removal, as the Berkey on its own does not take out fluoride.

Reverse Osmosis

RO systems are expensive ($200-$600 for basic home models, plus $50 filter changes 1-2 times per year), and discounted department store models may use inferior membranes, compromising performance. Systems require electricity to run, adding to expense and fallibility. RO filters often require a technician to install, if the consumer is not experienced with plumbing. The RO process discards 3-5 gallons of water for every gallon filtered. The massive waste of water alone leads us to feel reverse osmosis is not a sustainable solution for an increasingly drought-ridden period in time, when every drop of potable water should be considered a precious resource.

Activated Alumina

Frequently used in large-scale water treatment where excessive fluoride in groundwater is a problem. While promoted to remove over 90% of fluoride at home, pH needs to be low and flow needs to be slow in order to achieve the stated goals. Frequent cartridge replacement to maintain effectiveness adds to initial costs. Many variables make results uncertain, and repeated testing would be required to monitor system performance.

The Survival Still Water Purifier and Desalinator

Turn to the Survival Still when you want to be prepared for any and all possibilities, including natural or man-made disasters. This unit can make consistently pure water from any source in an emergency, even swimming pools, ponds, or seawater. Removes all contaminants including radioactive isotopes and organic pathogens. Requires some energy source to boil water, but no electricity. Works with your kitchen pots for easy storage.

Buying Water

Bottled water has been largely rejected by the environmental movement as representing a massive waste and mismanagement of resources in production, transport, and packaging. Buying filtered water from water services or local stores (*using reusable containers to fit a water dispenser*) can be a short-term solution. But most home filter systems will quickly pay for themselves, take up less space in your kitchen, and provide a more reliable clean water source. Some prepackaged "*spring water*" can actually contain fluoride and other questionable minerals, so always review the companies water analysis carefully before buying.

It's getting harder and harder to take a cool drink of water for granted. Across the country, battles continue to rage in communities large and small over whether adding fluoride to the public water supply is a safe, common-sense public service, or a sinister act of government-sponsored health endangerment. In Portland, Oregon, the impassioned debate centered around issues of personal choice and responsibility: if the facts are in question, who gets to decide what's in their water?

Ultimately, Portlanders voted "no" to fluoride. It's a decision each family must make based on available information. If your municipal water supply or private well contains unwanted fluoride, you have options to exercise your informed choice in your own home.

The EPA On Fluoride

There are no safe levels of fluoride in drinking water. The peer reviewed literature herein makes a clear case that the deleterious effects caused by fluoride occur with as little as 0.50 part per million fluoride and even less for children still in the womb whose mothers fluoride intake affects them directly.

In 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine the level of contaminants in drinking water at which no adverse health effects are likely to occur. These non-enforceable health goals, based solely on possible health risks and exposure over a lifetime with an adequate margin of safety, are called maximum contaminant level goals (MCLG). Contaminants are any physical, chemical, biological or radiological substances or matter in water.

The maximum contaminant level goals (MCLG) for fluoride is 4.0 mg/L or 4.0 ppm. That's high enough to cause disease in humans, to cause neurological and developmental damage, to cause cancer and to wreak havoc within the human body and this is especially so for children. EPA has set this level of protection based on their assessment of what they consider "*the best available science*" to prevent potential health problems. Yet "the best available science" claims otherwise. EPA has set an enforceable regulation for fluoride, called a maximum contaminant level (MCL), at 4.0 mg/L or 4.0 ppm. MCLs are set as close to the health goals as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies. In this case, the MCL equals the MCLG, because analytical methods or treatment technology do not pose any limitation. The CDC and the EPA see eye-to-eye on this issue so don't expect any protection from your government regulators. They're asleep at the wheel as usual.

Most developed nations do not fluoridate their water.
In western Europe, for example, only 3% of the population consumes fluoridated water.

While 25 countries have water fluoridation programs, 11 of these countries have less than 20% of their population consuming fluoridated water:

Argentina (19%)
Guatemala (13%)
Panama (15%)
Papa New Guinea (6%)
Peru (2%)
Serbia (3%)
Spain (11%)
South Korea (6%)
United Kingdom (11%)
Vietnam (4%)

Only 11 countries in the world have more than 50% of their population drinking fluoridated water:

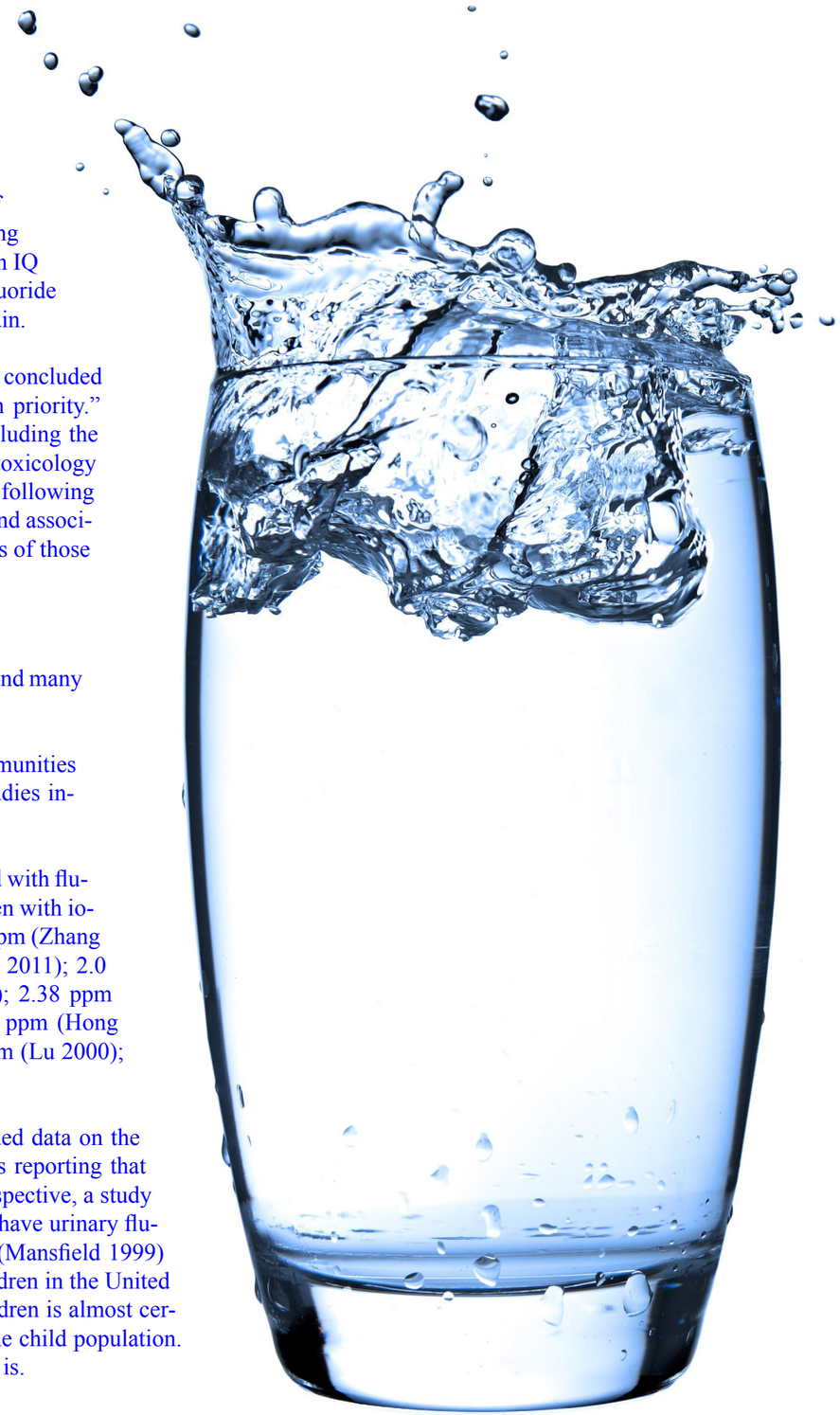
Australia (80%)
Brunei (95%)
Chile (70%)
Guyana (62%)
Hong Kong (100%)
Irish Republic (73%)
Israel (70%)
Malaysia (75%)
New Zealand (62%)
Singapore (100%)
United States (64%)

In total, 377,655,000 people or more worldwide drink artificially fluoridated water. This represents 5% of the world's population.

There are more people drinking fluoridated water in the United States than the rest of the world combined and there is no difference in tooth decay between western nations that fluoridate their water and those that do not.

As of February 2015, a total of 50 studies have investigated the relationship between fluoride and human intelligence, and a total of 33 studies have investigated the relationship fluoride and learning/memory in animals. Of these investigations, 43 of the 50 human studies have found that elevated fluoride exposure is associated with reduced IQ, while 31 of the 33 animal studies have found that fluoride exposure impairs the learning and/or memory capacity of animals. The human studies, which are based on IQ examinations of over 11,000 children, provide compelling evidence that fluoride exposure during the early years of life can damage a child's developing brain.

After reviewing 27 of the human IQ studies, a team of Harvard scientists concluded that fluoride's effect on the young brain should now be a "high research priority." (Choi, et al 2012). Other reviewers have reached similar conclusions, including the prestigious National Research Council (NRC), and scientists in the Neurotoxicology Division of the Environmental Protection Agency (Mundy, et al). On the following pages we summarize the results from almost all of the studies that have found associations between fluoride and reduced IQ and provide links to full-text copies of those studies.



Quick Facts About The Studies

• Location of Studies: China, India, Iran, Mexico, Japan, Australia, the UK and many other countries. Several are from the US but most are not.

• Sources of Fluoride Exposure: The majority of the studies involved communities where the predominant source of fluoride exposure was water; several studies investigated fluoride exposure from coal burning.

• Fluoride Levels in Water: IQ reductions have been significantly associated with fluoride levels of just 0.7 to 1.2 mg/L (Sudhir 2009); 0.88 mg/L among children with iodine deficiency. (Lin 1991) Other studies have found IQ reductions at 1.4 ppm (Zhang 2015); 1.8 ppm (Xu 1994); 1.9 ppm (Xiang 2003a,b); 0.3-3.0 ppm (Ding 2011); 2.0 ppm (Yao 1996, 1997); 2.1-3.2 ppm (An 1992); 2.3 ppm (Trivedi 2012); 2.38 ppm (Poureslami 2011); 2.45 ppm (Eswar 2011); 2.5 ppm (Seraj 2006); 2.85 ppm (Hong 2001); 2.97 ppm (Wang 2001, Yang 1994); 3.1 ppm (Seraj 2012); 3.15 ppm (Lu 2000); 3.94 ppm (Karimzade 2014); and 4.12 ppm (Zhao 1996).

• Fluoride Levels in Urine: About a quarter of the IQ studies have provided data on the level of fluoride in the children's urine, with the majority of these studies reporting that the average urine fluoride level was below 3 mg/L. To put this level in perspective, a study from England found that 5.6% of the adult population in fluoridated areas have urinary fluoride levels exceeding 3 mg/L, and 1.1% have levels exceeding 4 mg/L. (Mansfield 1999) Although there is an appalling absence of urinary fluoride data among children in the United States, the excess ingestion of fluoride toothpaste among some young children is almost certain to produce urinary fluoride levels that exceed 2 ppm in a portion of the child population. After reading this free PDF you'll quickly realize just how frightening that is.

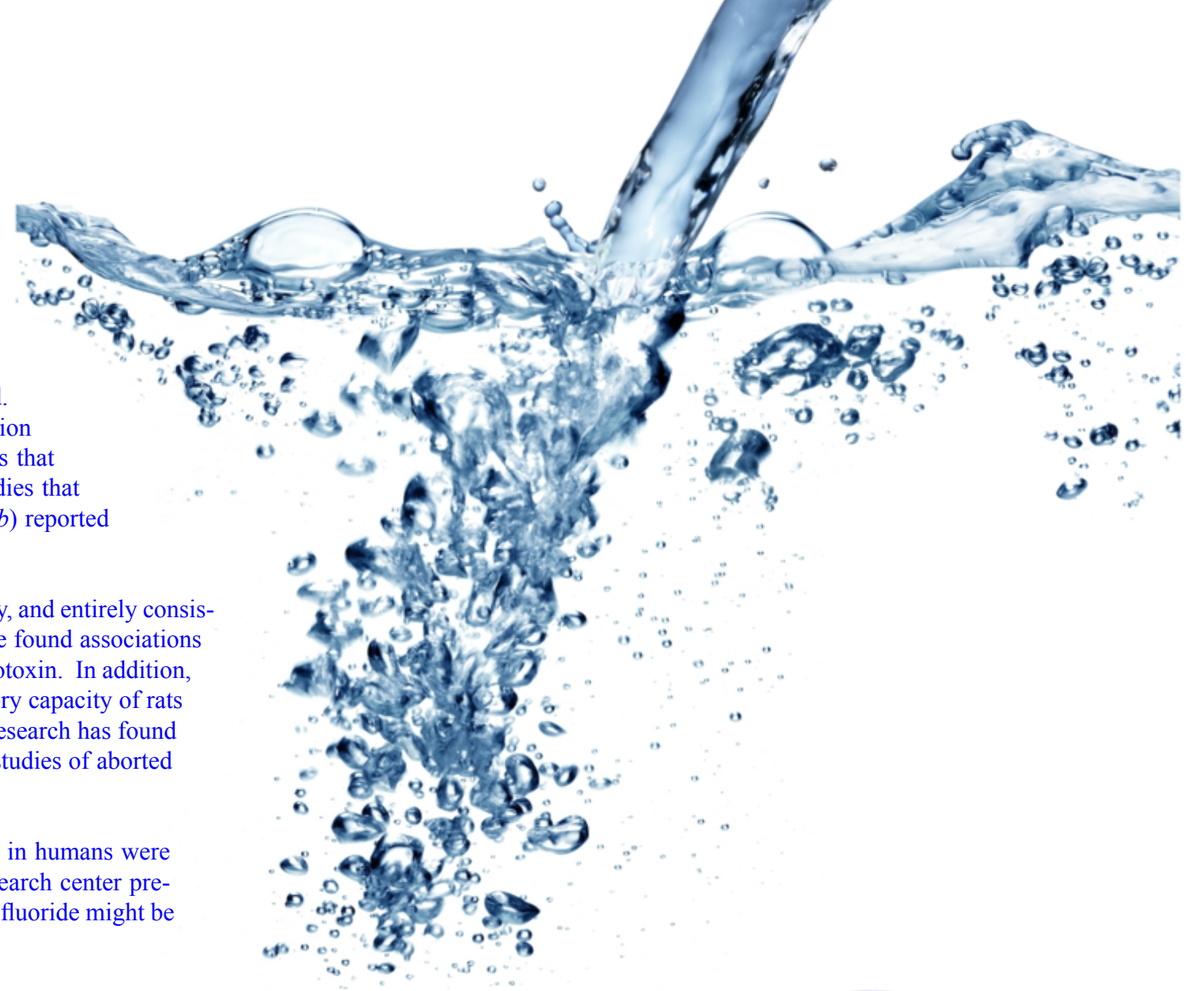
Methodological Limitations

As both the NRC and Harvard reviews have correctly pointed out, many of the fluoride/IQ studies have used relatively simple designs and have failed to adequately control for all of the factors that can impact a child's intelligence (*e.g., parental education, socioeconomic status, lead and arsenic exposure*). For several reasons, however, it is unlikely that these limitations can explain the association between fluoride and IQ.

First, some of the fluoride/IQ studies have controlled for the key relevant factors, and significant associations between fluoride and reduced IQ were still observed. This fact was confirmed in the Harvard review, which reported that the association between fluoride and IQ remains significant when considering only those studies that controlled for certain key factors (*e.g., arsenic, iodine, etc*). Indeed, the two studies that controlled for the largest number of factors (*Rocha Amador 2007; Xiang 2003a,b*) reported some of the largest associations between fluoride and IQ to date.

Second, the association between fluoride and reduced IQ in children is predicted by, and entirely consistent with, a large body of other evidence. Other human studies, for example, have found associations between fluoride and neurobehavior in ways consistent with fluoride being a neurotoxin. In addition, animal studies have repeatedly found that fluoride impairs the learning and memory capacity of rats under carefully controlled laboratory conditions. An even larger body of animal research has found that fluoride can directly damage the brain, a finding that has been confirmed in studies of aborted human fetuses from high-fluoride areas.

Finally, it is worth considering that before any of the studies finding reduced IQ in humans were known in the western world, a team of U.S. scientists at a Harvard-affiliated research center predicted (based on behavioral effects they observed in fluoride-treated animals) that fluoride might be capable of reducing IQ in humans. (Mullenix 1995)



Summary

When considering their consistency with numerous animal studies, it is very unlikely that the 43 human studies finding associations between fluoride and reduced IQ can all be a random fluke. The question today, therefore, is less whether fluoride reduces IQ, but at what dose, at what time, and how this dose and time varies based on an individual's nutritional status, health status, and exposure to other contaminants (e.g., aluminum, arsenic, lead, etc). Of particular concern is fluoride's effect on children born to women with suboptimal iodine intake during the time of pregnancy, and/or fluoride's effects on infants and toddlers with suboptimal iodine intake themselves. According to the U.S. Centers for Disease Control, approximately 12% of the U.S. population has deficient exposure to iodine.

On The Following Pages You'll Find Uncontested, Published, Peer Reviewed Reports and Studies Linking Fluoride To Reduced IQ, Brain Dysfunction And Much, Much More...

FLUORIDE AND THE HUMAN BRAIN

Neurotoxicology and Teratology
Volume 47, January–February 2015, Pages 96–101

Association of lifetime exposure to fluoride and cognitive functions in Chinese children: A pilot study

Anna L. Choi, Ying Zhang, Guifan Sun, David C. Bellinger,
Kanglin Wang, Xiao Jing Yang, Jin Shu Li, Quanmei Zheng,
Yuanli Fu and Philippe Grandjean

Elevated fluoride concentrations in drinking water may be neurotoxic. We carried out a pilot study of 51 first-grade children with stable lifetime fluoride exposures. Moderate and severe fluorosis was associated with deficits in digit span total and backward scores. The dose-dependence underlying the association needs to be characterized in detail.

Abstract/Background

A systematic review and meta-analysis of published studies on developmental fluoride neurotoxicity support the hypothesis that exposure to elevated concentrations of fluoride in water is neurotoxic during development.

Methods

We carried out a pilot study of 51 first-grade children in southern Sichuan, China, using the fluoride concentration in morning urine after an exposure-free night; fluoride in well-water source; and dental fluorosis status as indices of past fluoride exposure. We administered a battery of age-appropriate, relatively culture-independent tests that reflect different functional domains: the Wide Range Assessment of Memory and Learning (WRAML), Wechsler Intelligence Scale for Children-Revised (WISC-IV) digit span and block design; finger tapping and grooved pegboard. Confounder-adjusted associations between exposure indicators and test scores were assessed using multiple regression models.

Results

Dental fluorosis score was the exposure indicator that had the strongest association with the outcome deficits, and the WISC-IV digit span subtest appeared to be the most sensitive outcome, where moderate and severe fluorosis was associated with a digit span total score difference of − 4.28 (95% CI − 8.22, − 0.33) and backward score with − 2.13 (95% CI − 4.24, − 0.02).

Conclusions

This pilot study in a community with stable lifetime fluoride exposures supports the notion that fluoride in drinking water may produce developmental neurotoxicity, and that the dose-dependence underlying this relationship needs to be characterized in detail.

Link: http://www.ncbi.nlm.nih.gov/pubmed/25446012

Toxicology Science • January 1st, 2015

Modifying Effect of COMT Gene Polymorphism and a Predictive Role for Proteomics Analysis in Children's Intelligence in Endemic Fluorosis Area in Tianjin, China

Zhang S, Zhang X, Liu H, Qu W, Guan Z, Zeng Q, Jiang C, Gao H, Zhang C, Lei R, Xia T, Wang Z, Yang L, Chen Y, Wu X, Cui Y, Yu L, Wang A.

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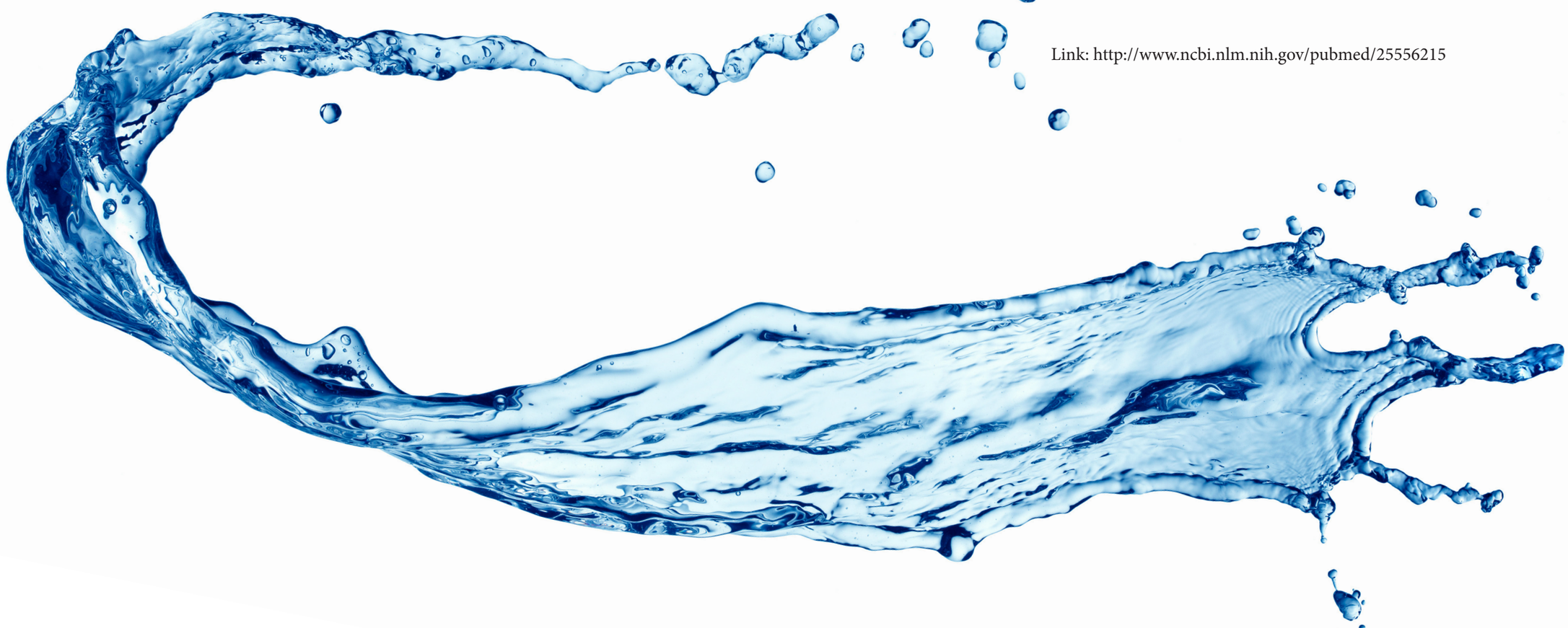
Abstract

Cumulative fluoride exposure has adverse influences on children's intelligence quotient (IQ). In addition, catechol-O-methyltransferase (COMT) gene Val158Met polymorphism (rs4680) is associated with cognitive performance. This study aimed to evaluate the associations of COMT polymorphism and alterations of protein profiles with children's intelligence in endemic fluorosis area. We recruited 180 schoolchildren (10-12 years old) from high fluoride exposure (1.40 mg/l) and control areas (0.63 mg/l) in Tianjin City, China. The children's IQ, fluoride contents in drinking water (W-F), serum (S-F), and urine (U-F); serum thyroid hormone levels, COMT Val158Met polymorphism, and plasma proteomic profiling were determined. Significant high levels of W-F, S-F, U-F, along with poor IQ scores were observed in the high fluoride exposure group compared with those in control (all $P<0.05$). S-F and U-F were inversely related with IQ ($rs=-0.47$, $P<0.01$; $rs=-0.45$, $P=0.002$). Importantly, higher fluoride exposure was associated with steeper cognitive decline among children with the reference allele Val compared with those homozygous or heterozygous for the variant allele Met (95% CI, -16.80 to 2.55; P interaction <0.01). Additionally, 5 up-regulated protein spots related to cell immunity and metabolism were detected in children with high fluoride exposure compared with the control. In conclusion, fluoride exposure was adversely associated with children's intelligence, whereas the COMT polymorphism may increase the susceptibility to the deficits in IQ due to fluoride exposure. Moreover, the proteomic analysis can provide certain basis for identifying the early biological markers of fluorosis among children.



Link: http://www.ncbi.nlm.nih.gov/pubmed/25556215

Investigation and analysis of the development of intelligence levels and growth of children in areas suffering fluorine and arsenic toxicity from pollution from burning coal

Author
Bai Z, Li Y, Fan Z, Li X, Li P.

Chinese Journal of Endemiology

Chinese (with FAN translation of Summary)
Publish Date: March 20, 2014

Abstract

Aim: To study the impacts on the development of intelligence and growth of children suffering fluorine and arsenic toxicity from pollution from burning coal.

Method: Areas suffering from significant morbidity and minor morbidity were selected for investigation from areas of southern Shaanxi Province suffering fluorine and arsenic toxicity from pollution from burning coal in 2011 and 2012. Areas not showing morbidity were selected as a control. Intelligence tests were conducted on school students 8–12 years old, and dental fluorosis and growth development were also tested. Differences in the development of intelligence and growth of the children between the various groups were analyzed. Urine samples were collected from children 8–12 years old, and the levels of urinary fluoride and urinary arsenic were determined.

Results: The median urinary fluoride levels for children 8–12 years old in the areas of significant, minor and no morbidity were, respectively, 1.96, 0.81 and 0.54 mg/L; the median urinary arsenic levels were, respectively, 0.023, 0.019 and 0.018 mg/L. The children's intelligence quotients were, respectively, 101.22±15.97, 104.83±12.78 and 107.92±13.62. The height, body weight, chest circumference and lung capacity in the areas of significant, minor and no morbidity were compared, and these differences were of statistical significance (?2=36.549, 25.859, 28.021 and 45.627, all P<0.01). The height, body weight, chest circumference and lung capacity of children in the areas of significant and minor morbidity (136 cm, 31 kg, 64 cm, 1,432 ml; 137 cm, 30 kg, 65 cm, 1,433 ml) were all less than those for the area of no morbidity (141 cm, 34 kg, 67 cm, 1,660 ml; Z values were, respectively, -5.858, -4.151, -4.196, -4.500; -5.189, -3.240, -6.698, -4.008, all P<0.01), and the lung capacity of children in the areas of significant morbidity was less than those from the areas of minor morbidity (Z=-2.395, P<0.05). The children's urinary fluoride and urinary arsenic levels versus intelligence [quotients] were both negatively correlated (r=-0.560, -0.353, all P<0.05).

Conclusion: Exposures to fluorine and arsenic are deleterious to the development of intelligence and the development of growth in children. We propose that stoves and furnaces be further upgraded to promote the healthy growth of children.

Link: http://fluoridealert.org/studytracker/19413/

International Research Journal of Medical Sciences

A correlation between Serum Vitamin, Acetylcholinesterase Activity and IQ in Children with Excessive Endemic Fluoride exposure in Rajasthan, India

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Abstract

Fluoride is widely distributed in nature and a direct source of adverse health effects in human populations. Fluoride poisoning attributed by long-term exposure to high levels of fluoride called fluorosis. The present study among 9-14 years old school children of Dausa district, Rajasthan India. The subjects were selected from high fluoride region (>2.0 ppm) and age matched were selected from Jaipur district where fluoride content was (<1.5 ppm). A set of question was used to collect information from the children's personal character, clinical health outcome, residential record, educational achievements and family socioeconomic status. Fluoride in serum, urine and drinking water were estimated in both subjects and controls along with serum vitamin (A, C, D and E) and acetylcholinesterase (AChE). The Raven's Standard Progressive Matrices was used to measurement of children's intelligence. IQ scores and serum F levels was directly correlated with the concentration of serum F level. Reduced concentration of vitamin (C, D and E) and AChE activity is the potent markers of neuro-degeneration. The conclusion of the study is that the excessive fluoride delineates the neuronal impairment which were evident by reduce IQ score and serum AChE activity. Moreover, the altered vitamin concentrations was carried out which may further lead to brain and bone damage.

Link: http://fluoridealert.org/wp-content/uploads/singh-2013.pdf

Fluoride Research Report • January-March 2014

Investigation of Intelligence Quotient of 9–12-year-old children exposed to high and low-drinking water fluoride in areas in Azerbaijan Province, Iran

by S Karimzade, M Aghaei, AH Mahvi
Tehran, Iran

Abstract

In order to investigate the relationship between fluoride (F) in drinking water and children's intelligence quotient (IQ), 39 9–12-year-old children in West Azerbaijan, were selected and their IQ measured using the Iranian version of the RB Cattell test. The study cases were 19 children living in a high-drinking water F region (3.94 mg F/L), and the control group was 20 children in a low-drinking water F region (0.25 mg F/L). The results showed that, the mean IQ of children living in the high-drinking water F region was lower (81.21±16.17) than that of children in the low-drinking water F region (104.25±20.73, p=0.0004). There is a significant linear trend for children in the high-drinking water F region to have a lower IQ (p=0.0067).

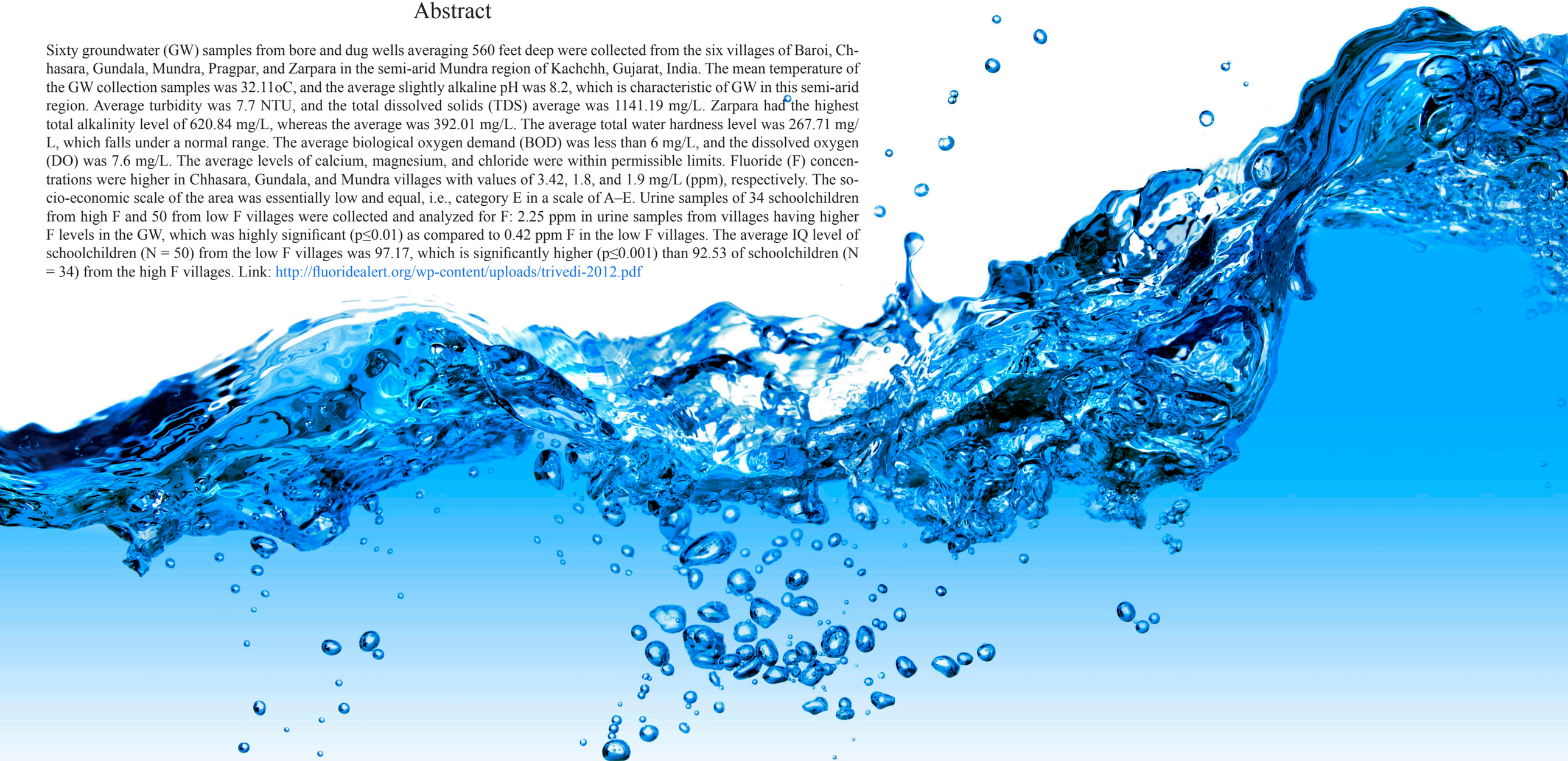
Link: http://fluoridealert.org/wp-content/uploads/karimzade-2014.pdf

Fluoride contamination of groundwater and its impact on IQ of schoolchildren in Mundra, Gujarat, India

by MH Trivedi, NP Sangai, RS Patel, M Payak, SJ Vyasa

Abstract

Sixty groundwater (GW) samples from bore and dug wells averaging 560 feet deep were collected from the six villages of Baroi, Chhasara, Gundala, Mundra, Pragpar, and Zarpara in the semi-arid Mundra region of Kachchh, Gujarat, India. The mean temperature of the GW collection samples was 32.11oC, and the average slightly alkaline pH was 8.2, which is characteristic of GW in this semi-arid region. Average turbidity was 7.7 NTU, and the total dissolved solids (TDS) average was 1141.19 mg/L. Zarpara had the highest total alkalinity level of 620.84 mg/L, whereas the average was 392.01 mg/L. The average total water hardness level was 267.71 mg/L, which falls under a normal range. The average biological oxygen demand (BOD) was less than 6 mg/L, and the dissolved oxygen (DO) was 7.6 mg/L. The average levels of calcium, magnesium, and chloride were within permissible limits. Fluoride (F) concentrations were higher in Chhasara, Gundala, and Mundra villages with values of 3.42, 1.8, and 1.9 mg/L (ppm), respectively. The socio-economic scale of the area was essentially low and equal, i.e., category E in a scale of A–E. Urine samples of 34 schoolchildren from high F and 50 from low F villages were collected and analyzed for F: 2.25 ppm in urine samples from villages having higher F levels in the GW, which was highly significant ($p \leq 0.01$) as compared to 0.42 ppm F in the low F villages. The average IQ level of schoolchildren (N = 50) from the low F villages was 97.17, which is significantly higher ($p \leq 0.001$) than 92.53 of schoolchildren (N = 34) from the high F villages. Link: http://fluoridealert.org/wp-content/uploads/trivedi-2012.pdf



Effect of fluoride exposure on the intelligence of school children in Madhya Pradesh, India

Authors
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Date of Web Publication • July 2012

Abstract

Objective: To assess the relationship between exposure to different drinking water fluoride levels and children's intelligence in Madhya Pradesh state, India. Materials and Methods: This cross-sectional study was conducted among 12-year-old school children of Madhya Pradesh state, India. The children were selected from low (< 1.5 parts per million) and high (≥1.5 parts per million) fluoride areas. A questionnaire was used to collect information on the children's personal characteristics, residential history, medical history, educational level of the head of the family, and socioeconomic status of the family. Levels of lead, arsenic, and iodine in the urine and the levels of fluoride in the water and urine were analyzed. The children's intelligence was measured using Raven's Standard Progressive Matrices. Data analysis was done using the chi-square, one way analysis of variance, simple linear regression, and multiple linear regression tests. P value <0.05 was considered statistically significant. Results: Differences in participant's sociodemographic characteristics, urinary iodine, urinary lead, and urinary arsenic levels were statistically not significant (P>0.05). However, a statistically significant difference was observed in the urinary fluoride levels (P 0.000). Reduction in intelligence was observed with an increased water fluoride level (P 0.000). The urinary fluoride level was a significant predictor for intelligence (P 0.000).

Conclusion

Children in endemic areas of fluorosis are at risk for impaired development of intelligence.

Link: http://www.ruralneuropractice.com/article.asp?issn=0976-3147;year=2012;volume=3;issue=2;spage=144;epage=149;aulast=Saxena

Journal of Hazardous Materials • Feb 28th, 2011

The relationships between low levels of urine fluoride on children's intelligence, dental fluorosis in endemic fluorosis areas in Hulunbuir, Inner Mongolia, China

Ding Y1, YanhuiGao, Sun H, Han H, Wang W,
Ji X, Liu X, Sun D.

Abstract

There has been public concern about children's intellectual performance at high levels of fluoride exposure, but few studies provide data directly to the question of whether low fluoride exposure levels less than 3.0 mg/L in drinking water adversely associated with children's intelligence. In this survey, we investigated the effects of low fluoride exposure on children's intelligence and dental fluorosis. 331 children aged from 7 to 14 were randomly recruited from four sites in Hulunbuir City, China. Intelligence was assessed using Combined Raven Test-The Rural in China while dental fluorosis was diagnosed with Dean's index. Mean value of fluoride in drinking water was 1.31±1.05 mg/L (range 0.24-2.84). Urine fluoride was inversely associated with IQ in the multiple linear regression model when children's age as a covariate variable was taken into account ($P<0.0001$). Each increase in 1 mg/L of urine fluoride associated with 0.59-point decrease in IQ ($P=0.0226$). Meanwhile, there was a dose-response relationship between urine fluoride and dental fluorosis ($P<0.0001$).

In conclusion, our study suggested that low levels of fluoride exposure in drinking water had negative effects on children's intelligence and dental health and confirmed the dose-response relationships between urine fluoride and IQ scores as well as dental fluorosis.

Link: http://www.ncbi.nlm.nih.gov/pubmed/21237562

Journal of Dentistry and Oral Hygiene

Intelligence quotient of 7 to 9 year-old children from an area with high fluoride in drinking water

Authors

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Accepted February 21st, 2011

Abstract

This paper reports the effect of chronic high fluoride exposure on children`s intelligence quotient (IQ). In this cross sectional study, two urban communities with similar socio-economic and cultural status but with different levels of fluoride in drinking water, in Kerman province of Iran were studied: Koohbanan City (fluoride 2.38 mg/L), Baft City (fluoride 0.41 mg/L). Study samples consisted of 119 children 6 to 9 years old: 59 children from Koohbanan and 60 children from Baft. Raven`s progressive matrices used to determine the effect of fluoride exposures on children`s IQ. The statistical analysis was carried out using the t-test, the chi-square test and the Mann-Whitney test. In the low fluoride area (control group), the mean IQ score of children was 97.80±15.95 that decreased to 91.37±15.63 for the high fluoride group (Koohbanan`s children), it was significantly different from the control group ($P<0.05$). Although fluoride is widely promoted for prevention of dental caries, its overconsumption may lead to dental fluorosis and other adverse effects. Based on the findings, the chronic exposure to high levels of fluoride can be one of the factors that influence intellectual development. Therefore, it is necessary to think about some solutions for preventing the bad effects of excessive intake of fluoride ion to the body, especially in cities like Koohbanan.

Link: http://www.fluoridealert.org/wp-content/uploads/poureslami-2011.pdf

Journal of Indian Society
of Pedodontics and Preventive Dentistry

Relation between dental fluorosis and intelligence quotient in school children of Bagalkot district

by PK Shivaprakash, Kushagra Ohri, Hina Noorani
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P.M.N.M Dental College and Hospital
Bagalkot, Karnataka, India

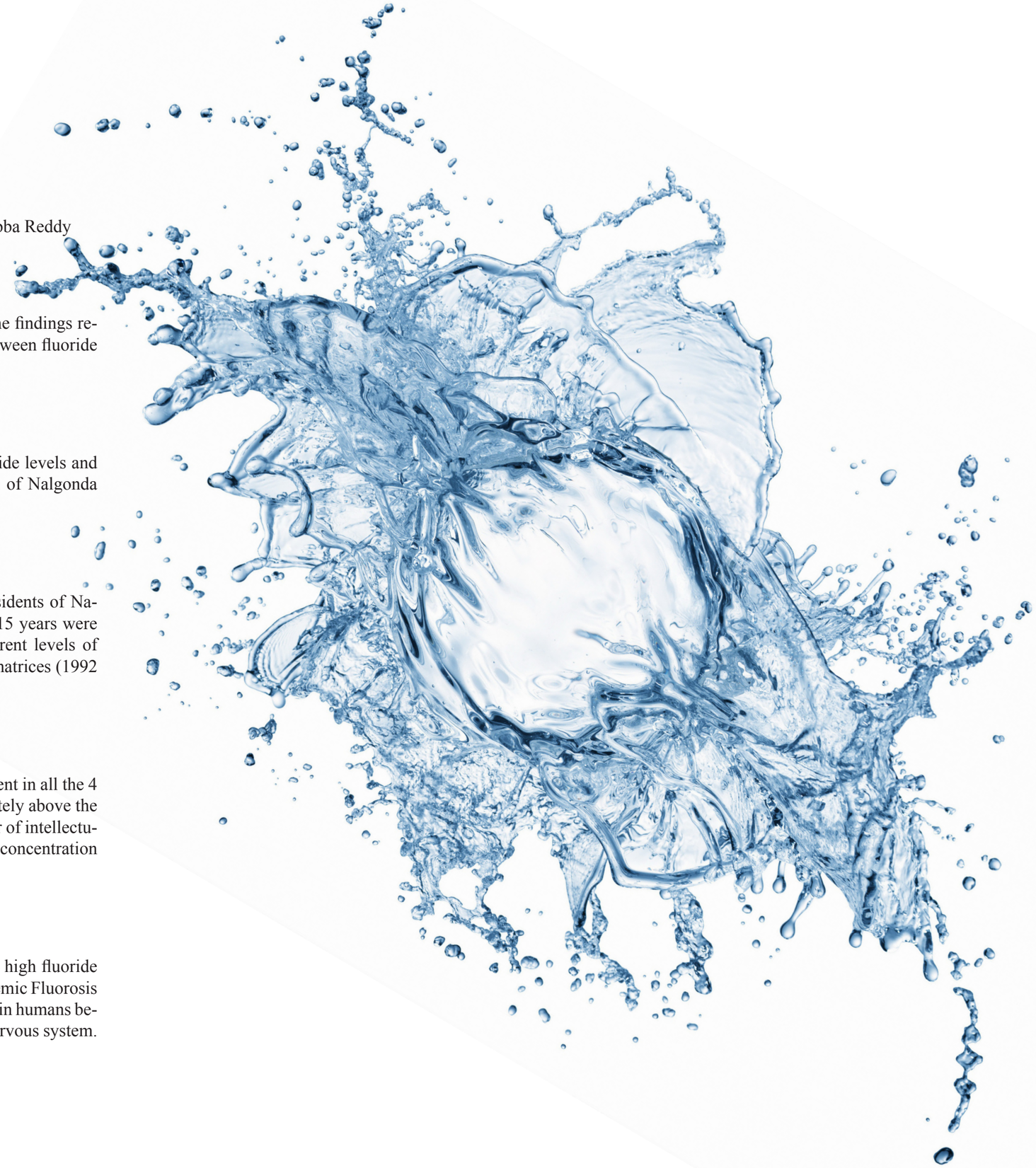
Abstract

This study was conducted on 160 children, in the Bagalkot district of Karnataka state between August and October 2010, with the aim of finding out if there is a relation between dental fluorosis status and Intelligence Quotient (IQ). Children were categorized as, those suffering from dental fluorosis and those not suffering from dental fluorosis and for all children in both categories, Intelligence testing was done using the Raven's Coloured Progressive Matrices. The following observations were made from the data gathered: The mean IQ score of children without dental fluorosis was significantly higher than those children who had dental fluorosis. The mean IQ scores did not vary with the severity of dental fluorosis as classified by Dean's fluorosis index. Also it was noticed that the percentage of children with dental fluorosis was more in Extremely Low and Low IQ categories whereas the percentage of children without dental fluorosis was more in Average and High Average IQ categories. Previous studies had indicated toward decreased Intelligence in children exposed to high levels of fluoride and our study also confirmed such an effect.

Link: http://www.jisppd.com/article.asp?issn=0970-4388;year=2011;volume=29;issue=2;spage=117;epage=120;aulast=Shivaprakash

Effect of fluoride exposure on Intelligence Quotient (IQ) among 13-15 year old school children of known endemic area of fluorosis, Nalgonda District, Andhra Pradesh

by Dr. K.M. Sudhir, G.N. Dr. Chandu, Dr. G.M. Prashant and Dr. V.V. Subba Reddy



Abstract

Waning controversy over fluoride and water fluoridation is rekindling with the findings released from certain fluoride studies which reported an inverse association between fluoride exposure and intelligence.

Objective

To assess the relationship between exposure to different drinking water fluoride levels and children's Intelligence Quotient (IQ) among 13-15 year old school children of Nalgonda District, Andhra Pradesh.

Methodology

An analytical cross sectional study was conducted among the permanent residents of Nagonda District of Andhra Pradesh. A total of 1000 school childr~n aged 13-15 years were selected by stratified random sampling from four different areas with different levels of naturally occurring fluoride in drinking water. Raven's standard progressive matrices (1992 Edition) were used for assessment of Intelligence Quotient (IQ) of children.

Results

Intellectually superior (Grade I) scores for individual IQ assessment were absent in all the 4 different fluoride levels. Only 0.8% of children were present in Grade l(definitely above the average in intellectual capacity) scores except in 4th level (>4.1ppm). Number of intellectually impaired children were gradually increased with the increase in fluoride concentration in the drinking water.

Conclusion

Findings of this study suggest that overall IQ levels in children's exposed to high fluoride level were significantly lower than the low fluoride areas. In view of many endemic Fluorosis areas in India, it is needed that further studies be conducted to examine the link in humans between fluoride & disturbances of the development & function of the central nervous system.

Link: http://fluoridealert.org/wp-content/uploads/sudhir-2009.pdf

The Impact of Endemic Fluorosis Caused by the Burning of Coal on the Development of Intelligence in Children

by Li, Fenghua, Xin, Renjian and Yuanfu

Abstract

We randomly selected 20 school children from 4 areas between the ages of 8-12, whose characteristics fit the scope of our research. They were chosen from slight, moderate, and severe endemic fluorosis areas that were affected by regional fluoride poisoning brought on by the burning of coal, and a controlled, non-endemic area. We have used the used the CRT-RC to perform a test of the children's intelligence levels, and we have examined the condition of their dental fluorosis. Urine samples were collected in the morning, and the fluoride content in the samples was measured by the fluoride ion selective electrode method.

Results

We have found that those more severely impacted by dental fluorosis had a higher level of fluoride in their urine samples ($P<0.01$). A significant difference in the children's levels of IQ could be observed amongst the different disease areas. The children's level of IQ tended to decrease as the severity of dental fluorosis increased. There was a negative correlation between the children's IQ level and urinary fluoride content ($P<0.01$). Significant differences could be seen in the abilities of comparative inference, serial relationship, and abstract inference between the different groups tested ($P<0.05$). In terms of cognition and analogical comparison abilities, the difference was not significant among the children from the different disease groups ($P>0.05$).

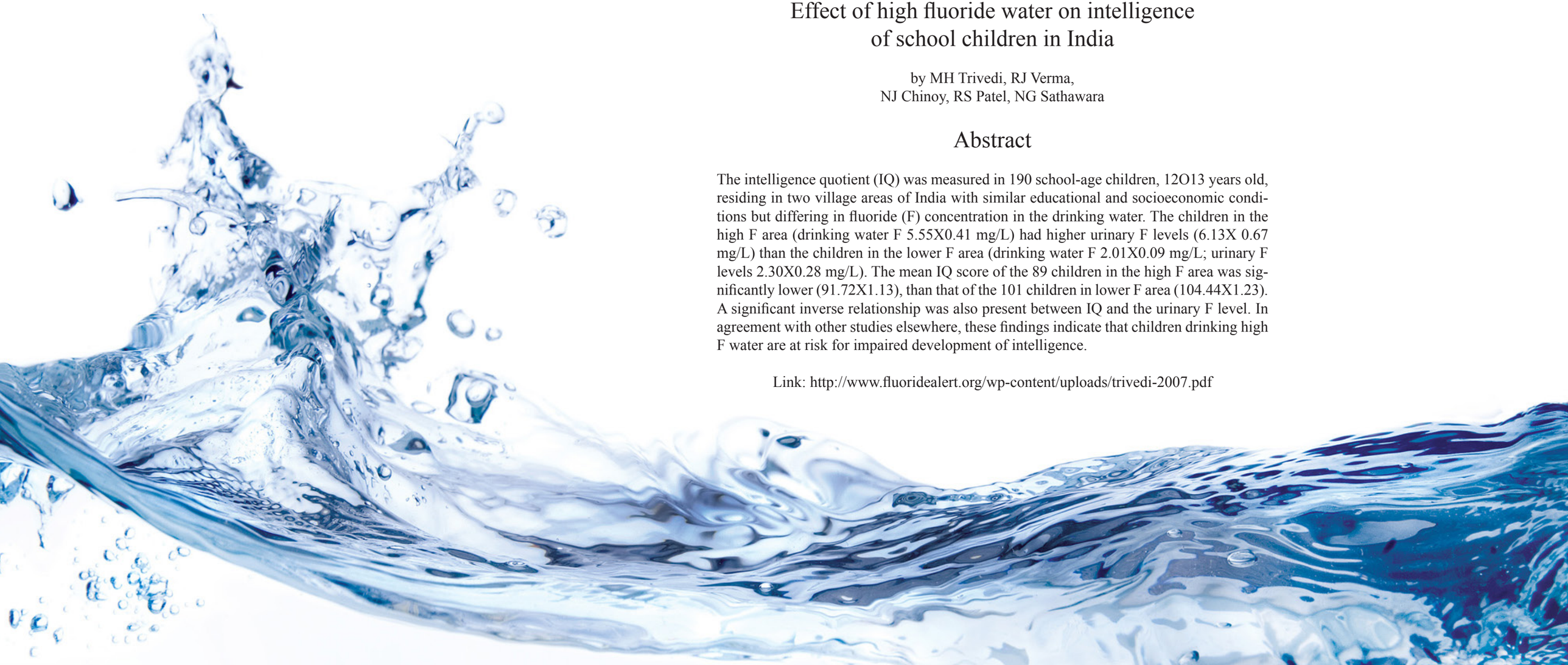
Conclusion

High exposure to fluoride most definitely has an adverse effect on the development of intelligence in children, in particular on the capability of abstract inference.

The most crucial period of development for the human brain is when one is still a fetus, and when one approaches infancy. An overdose of various types of elements, or lack thereof, in one's surrounding environment can have a highly negative impact on the development of the brain and nervous system. Research on the poisonous effect of fluoride in recent years has shown that an overdose of fluoride can be damaging to the central nervous system.

If, during pregnancy, the mother ingests a higher than normal amount of fluoride, the fluoride can be transferred from the placenta to the actual body of the fetus and negatively affect its normal development. If, after birth, the child is continually subjected to living in an endemic environment, the child could be taking in more fluoride than needed. In particular, if the child has an overdose of fluoride between the time of birth up until the age of 8, the fluoride may penetrate the blood-cerebrospinal fluid barrier to affect the development of the child's brain in different phases. This will then cause different degrees of negative impacts on the child's intelligence level and functionality of his nervous system.

Link: http://www.fluoridealert.org/wp-content/uploads/li-2009.pdf



Effect of high fluoride water on intelligence of school children in India

by MH Trivedi, RJ Verma,
NJ Chinoy, RS Patel, NG Sathawara

Abstract

The intelligence quotient (IQ) was measured in 190 school-age children, 12O13 years old, residing in two village areas of India with similar educational and socioeconomic conditions but differing in fluoride (F) concentration in the drinking water. The children in the high F area (drinking water F 5.55X0.41 mg/L) had higher urinary F levels (6.13X 0.67 mg/L) than the children in the lower F area (drinking water F 2.01X0.09 mg/L; urinary F levels 2.30X0.28 mg/L). The mean IQ score of the 89 children in the high F area was significantly lower (91.72X1.13), than that of the 101 children in lower F area (104.44X1.23). A significant inverse relationship was also present between IQ and the urinary F level. In agreement with other studies elsewhere, these findings indicate that children drinking high F water are at risk for impaired development of intelligence.

Link: http://www.fluoridealert.org/wp-content/uploads/trivedi-2007.pdf

The Effect of High Fluoride Exposure on the Level of Intelligence in Children

Fan, Zhongxue1, Dai, Hongxing1, Bai, Aimei1, Li, Pingan1, RO, Li1, Li, Guangde2, Zhang, Chongyi3, LI, Xiaoxian1

1 The Shaanxi Provincial Institute for Endemic Disease Control, Xi'an, Shaanxi
2 Regional Epidemics Unit of the Disease Control and Prevention Center of Weinan
3 The Epidemics Unit of the Disease Control and Prevention Center of Pucheng

Objective

Investigate the effect of high fluoride exposure on the level of intelligence in children

Methodology

In May 2006, 42 children from a high endemic fluorosis group and 37 children from the control area (who have been consuming low-fluoride water after water improvement schemes) were chosen for the test. They are all from a primary school in Pucheng county, Shaanxi province. Their level of intelligence was tested, and a test for dental fluorosis was conducted using Dean's method, and the level of fluoride in urine was determined with a fluoride ion selective method.

Results

The average intelligence level of the children in the high fluoride group (96.11 +- 12.00) was lower than that of the control group (98.41 +- 14.75). We have not found any children with an intelligence level exceeding a level deemed as excellent; as for the intelligence distribution in these groups, there is little statistical significance. There was a negative correlation between the urine fluoride concentration and the level of intelligence in children (P>0.05).

Conclusion

Exposure to high levels of fluoride is likely to cause a certain level of harm to a child's level of intelligence.

Link: http://www.fluoridealert.org/wp-content/uploads/fan-2007.pdf

Journal of Applied Clinical Pediatrics 2005

The effects of endemic fluoride poisoning caused by coal burning on the physical development and intelligence of children

by Shouying Wang, Hexi Zhang, Wei Fan, Shijie Fang, Peiping Kang, Xuguang Chen, Maojuan Yu

Abstract

To investigate the effects of endemic fluoride poisoning caused by coal burning on the physical development and intellectual ability of children. Method: Using random sampling from the relevant population, 176 fluorosis sufferers aged 7– 12 (the subjects) were drawn from a heavily fluoride poisoned area of Zhijin County, with 50 children without dental fluorosis (the control) selected from a less severely poisoned area. The children were subjected to tests to determine levels of urinary fluoride, physical development, and intellectual ability, followed by analysis of the various measurements.

Results

Compared to the control group, the fluorosis group showed retarded physical development, and the levels of urinary fluoride and intellectual ability were both lower than the control ($P < 0.05$ for both).

Conclusion

High fluoride burden has a definite effect on the intellectual and physical development of children.

Link: http://www.researchgate.net/publication/237230630_THE_EFFECTS_OF_ENDEMIC_FLUORIDE_POISONING_CAUSED_BY_COAL_BURNING_ON_THE_PHYSICAL_DEVELOPMENT_AND_INTELLIGENCE_OF_CHILDREN

Fluoride Vol. 36 No. 3
Pages 198-199, 2003 • Letter to the Editor

Blood lead of children in Wamiao-Zinhuai Intelligence Study

Abstract

As an additional part of our investigation of an association between fluoride in drinking water and children's intelligence in two villages of Sihong County, Jiangsu Province, China, we have now determined blood lead levels of children in that study.

Methodology

Blood samples (80 µL) were collected on June 18 and 19, 2003 from the index finger of 71 randomly selected 8 to 13 year-old children in the high fluoride village of Wamiao and 67 children of the same ages in the low fluoride village of Xinhuai. The samples were preserved in clean plastic centrifuge tubes containing 0.64 mL of Triton X-100. Blood lead was measured within one week by atomic absorption spectrophotometry.

Conclusion

Prenatal and early childhood exposure to lead is now well recognized to be an important cause of mental impairment, and this effect has recently been correlated with blood lead levels in children that are lower than previously thought to be safe. However, we found no difference in the low blood lead concentrations of the children in high-fluoride, lower IQ Wamiao and low-fluoride, higher IQ Xinhuai. These results thus make it very unlikely that the differences in IQ of the children living in Wamiao and Xinhuai are the result of differences in exposure to lead rather than to fluoride.

Link: http://www.fluorideresearch.org/363/files/FJ2003_v36_n3_p198-199.pdf

Initial Study of Cognitive Function Impairment as Caused by Chronic Fluorosis

Shao, Quanli1, Wang, Yanan2, LI, Liangwen3, LI, Jian4

1 CGuiyang Medical College, Guiyang 550004, China
2 Biochemical Department of Stockholm University, Rasundouagen 0046-16967
3 Nayong County Hospital of Guizhou, Nayong 553300, Guizhou Province, China
4 Clinical Office of Guizhou Military Area, Guiyang 550002, Guizhou Province, China

Abstract

Objective: To investigate whether an impairment in cognitive function exists in patients diagnosed with fluoride poisoning as well as its biological basis.

Methods

Individuals suffering from fluoride poisoning from a high fluorine region were selected for the study group, while healthy individuals from a non-endemic region were selected as the control group. Using specific psychological methods, the indices of blood oxidative stress were also tested with the following: Thiobarbituric acid reaction (TBA) for serum lipid peroxide (LPO), Ellman's for reduced glutathione (GSH) in serum, nitrite method for superoxide dismutase (SOD) in red blood cells, and the Dithiobis-nitrobenzoic acid (DTNB) method for glutathione peroxidase (GSH-Px) in serum. As to determining the amount of NO in the subjects, this was done through testing the nitrous and nitrate (NO2-/ NO3-) in serum.

Results

Between the study group and the control group, significant differences were observed in the data gathered from the psychological tests. Big differences were found in the tests of language fluency, recognition, similarity, associative learning, and working memory (digit span test). The total failure numbers from the psychological tests and the concentration of NO demonstrated a significant positive correlation, while the similarity test showed a significant negative correlation. SOD activity showed a significant negative correlation with the similarity and digit span tests.

Conclusion

The results suggest that some cognitive function limitations exist in those suffering from chronic fluoride poisoning, and its biologic basis may be related to the levels of SOD and NO.

Link: http://www.fluoridealert.org/wp-content/uploads/shao-2003.pdf

Effects of High Iodine and High Fluorine on Children's Intelligence and Thyroid Function

by Wang, Xiuhong, Wang, Lingfang,
Hu, Piying, Guo, Xiaowei, Luo, Xiaohong
Shandong Institute of Prevention and
Treatment of Endemic Disease
Jinana, Shandong Province

Abstract

Objective: Try to find out the effects of high iodine and high fluorine on children's intelligence and thyroid function.

Methodology

We selected in Qingyun County the Lidian Primary School, where the iodine and fluorine in the water are relatively high in concentration as the investigative point and Dading Primary School where the iodine and fluorine in the water have normal concentration as the control point. The high iodine goiter rate, dental fluorosis, IQ and thyroid metabolism indicators of the students aged 8 to 12 from the two schools were examined.

Results

In high iodine and high fluorine areas, the goiter rate and dental fluorosis of 8~12 years children were 29.8% and 72.98%. The children's average intelligence quotient (IQ) was 76.67±7.75, slightly lower than comparison point, but low intelligent pupil was 16.67%. The urinary iodine and urinary fluoride were (816.25±1.80) μg/L and (3.08±1.03) mg/L separately, clearly higher than comparison point. The thyroid iodine-131 uptake rates were visible lower. The value of 3h and 24h were respectively (9.36±1.55)% and (9.26±4.63)%. The serum TSH level was obviously higher than comparison point.

Conclusions

High iodine and high fluorine have certain influence on children's intelligence and thyroid function.

Link:
http://www.fluoridealert.org/wp-content/uploads/wang-2001.pdf

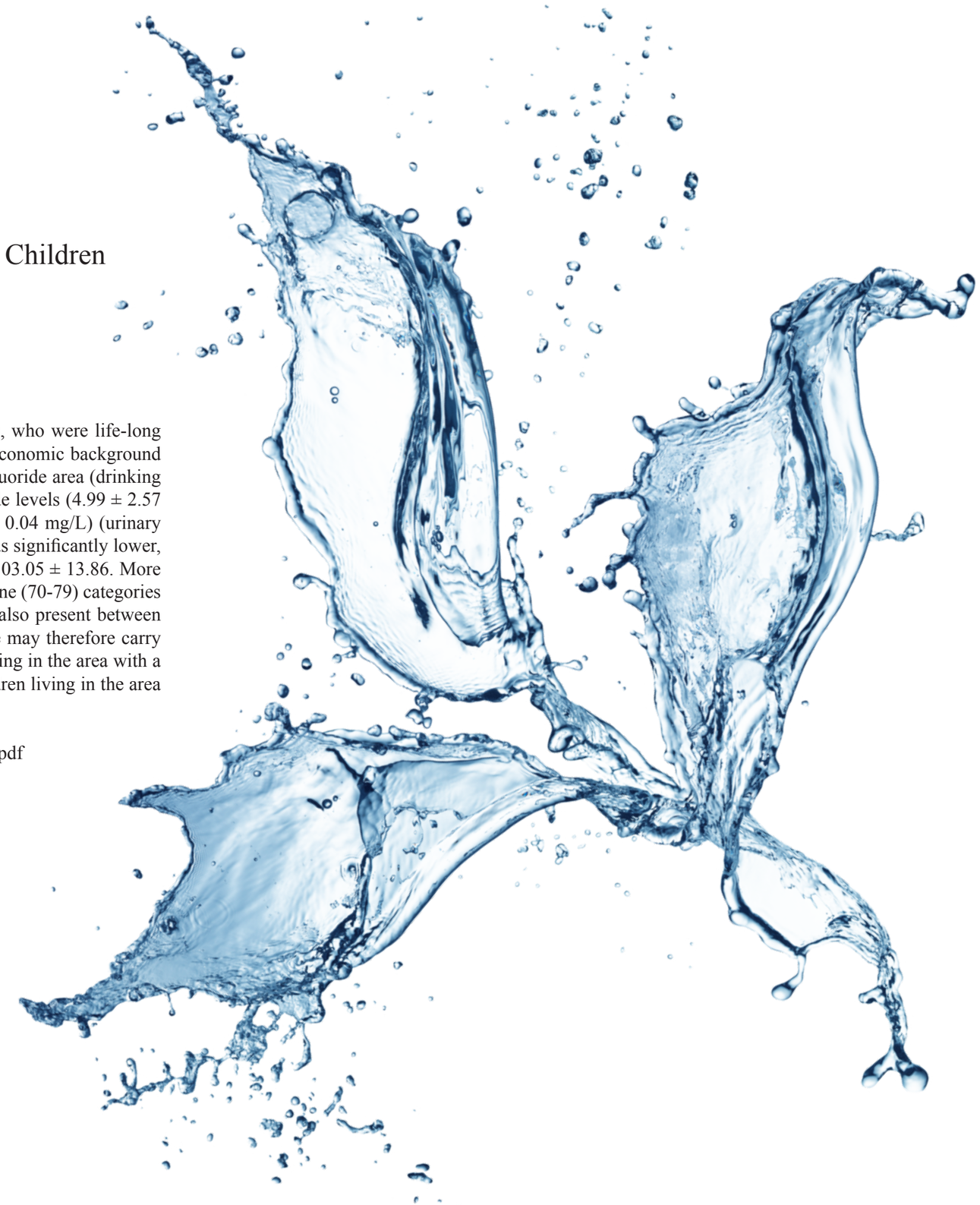
Effect Of High-Fluoride Water On Intelligence In Children

Y Lu, ZR Sun, LN Wu, X Wang, W Lu, SS Liu
Tianjin, China

Summary

The Intelligence Quotient (IQ) was measured in 118 children, aged 10-12 years, who were life-long residents in two villages of similar population size and social, educational and economic background but differing in the level of fluoride in drinking water. The children in the high-fluoride area (drinking water fluoride 3.15 ± 0.61 mg/L [ppm]) (mean ± S.D.) had higher urinary fluoride levels (4.99 ± 2.57 mg/L) than the children in the low-fluoride area (drinking water fluoride 0.37 ± 0.04 mg/L) (urinary fluoride 1.43 ± 0.64 mg/L). The IQ of the 60 children in the high-fluoride area was significantly lower, mean 92.27 ± 20.45, than that of the 58 children in the low-fluoride area, mean 103.05 ± 13.86. More children in the high-fluoride area, 21.6%, were in the retardation (<70) or borderline (70-79) categories of IQ than children in the low fluoride area, 3.4%. An inverse relationship was also present between IQ and the urinary fluoride level. Exposure of children to high levels of fluoride may therefore carry the risk of impaired development of intelligence. The mean IQ of the children living in the area with a high-fluoride level in drinking water was significantly lower than that of the children living in the area with a low-fluoride level in drinking water.

Link: http://www.fluoridealert.org/wp-content/uploads/lu-2000.pdf



Comparative Assessment of the Physical and Mental Development of Children in an Endemic Fluorosis Area with and without Water Improvement Programs

Yao, Luming1, Deng, Yi2, Yang, Shuyun3,
Zhou, Jinglin1, Wang, Xiuling1, Cui, Zhengwei1

1 Chaoyang Municipal Local Disease Prevention Bureau of Liaoning Province
2 Lingyuan Municipal Wanyuandian Hospital of Liaoning Province
3 Chaoyang Municipal Longcheng District Bianzhangzi Hospital of Liaoning Province

Abstract

Tests were performed to compare the IQ and physical development of 7-to-14-year-old children from endemic fluorosis areas, with and without water improvement programs, with children from a non-fluorosis area. The results showed that the average IQ of children in each age group from the fluorosis area without water improvement is lower than those from either the fluorosis area with water improvement or the non-fluorosis area ($P<0.01$). When comparing 7-to-8-year-old children born after the implementation of the water improvement program to children of the same age group in the non-fluorosis area, no obvious difference was found. Comparisons of the height, weight, and sitting height of children in the fluorosis area without water improvement and the fluorosis area with water improvement revealed an obvious difference for the 12-to-14-year-old age group. No obvious differences were found between the fluorosis area with water improvement and the non-fluorosis area. These results show that water improvement and defluoridation can improve the mental and physical development of children in a fluorosis area.

Link: http://www.fluoridealert.org/wp-content/uploads/yao-1997.pdf

Analysis on the Correlation Between TSH and Intelligence in Children with Dental Fluorosis from Endemic Fluorosis Regions

Yao, Luming, Zhou, Jinglin, Wang, Xiuling, Cui, Qicheng, Lin, Fengyan

Abstract

Fluoride is one of the indispensable elements for the living being. Excess amounts of fluoride, however, may damage the teeth and bones. Fluoride may also injure the body's soft tissues, resulting in nonskeletal fluorosis. To further investigate the influence of endemic fluorosis on childhood thyroid function and intelligence, we have selected school-aged children inflicted with dental fluorosis as the subject of our study. These children are from a region impacted with endemic fluorosis: Chaoyang City of Liaoning Province. The children in the study were tested for TSH (Thyroid Stimulating Hormone) and intelligence, and meaningful results were found. The results are reported in the following text.

Conclusions

The results of the intelligence tests show that a high level of fluoride influences children's IQ, which is consistent with some previous data. It is worth mentioning that the higher the degree of dental fluorosis, the more negative the impact on the children's intelligence level. This is an issue which merits utmost attention. We believe that the low intelligence of children has no relation to the level of TSH. Although there are differences found in TSH values between the endemic area and non-endemic area groups, and between the lightly endemic and severely endemic groups, the individual values are all within the normal range. The endemic and non-endemic area groups are all control areas of iodine deficiency. Although the subjects were found to suffer from dental fluorosis, no thyroid goiter were found on them. The TSH value rises with the level of the fluoride endemic area (from light to heavy degree) and is the result of interference by high fluoride.

Link: http://www.fluoridealert.org/wp-content/uploads/yao-1996.pdf

Effect of a high fluoride water supply on children's intelligence

L B Zhao, G H Liang, D N Zhang and X R Wu, Lu-Liang

Introduction

It has been reported that fluoride can penetrate the fetal blood-brain barrier and accumulate in cerebral tissue before birth, thereby apparently affecting children's intelligence? In the present study, conducted in April 1993, this hypothesis was further investigated by comparing the performance on IQ tests administered to 320 randomly selected children, age 7 to 14, residing in central Shanxi Province, China, in two suburban villages with significantly different fluoride content in the drinking water.

Most children in both Sima and Xinghua had IQ scores in the normal range of 90-109 or above. At the low end, however, 6 children (3.75% of the total) in Sima had scores of 69 or below (low intelligence), whereas only one child (0.62%) in Xinghua was in this category. On the other hand, the number of children with IQ scores of 120 or higher (superior intelligence) was 27 (17%) in Xinghua but was only 20 (12%) in Sima.

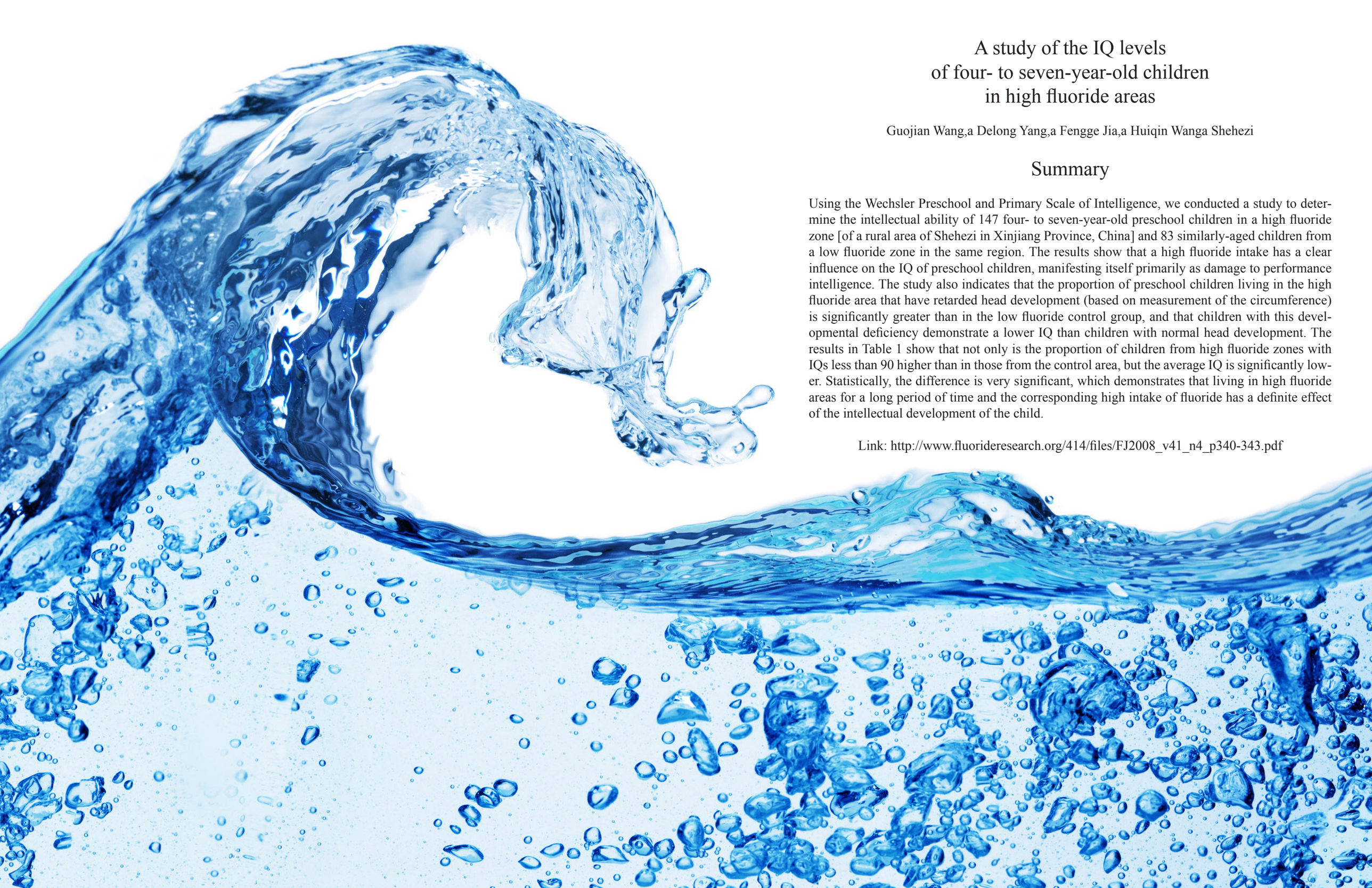
Although IQ increased with age, it did not go as high in Sima as in Xinghua.

Discussion

The results of this study indicate that intake of high-fluoride drinking water from before birth has a significant deleterious influence on children's IQ in one of two similar villages. No real differences were found for gender. In the high-fluoride village of Sima the number of children with IQ of 69 or below was six times that in the healthier low-fluoride village of Xinghua. There were also fewer children (20) in Sima with superior IQ scores of 120 or higher than the number (27) in Xinghua.

Moreover, the fact that the IQ scores increased more slowly with age in Sima than in Xinghua supports the view that exposure to high levels of fluoride in utero exerts a cumulative adverse effect that is not overcome with increasing age in a high-fluoride community.

Link: http://www.fluorideresearch.org/294/files/FJ1996_v29_n4_p190-192.pdf



A study of the IQ levels of four- to seven-year-old children in high fluoride areas

Guojian Wang,a Delong Yang,a Fengge Jia,a Huiqin Wanga Shehezi

Summary

Using the Wechsler Preschool and Primary Scale of Intelligence, we conducted a study to determine the intellectual ability of 147 four- to seven-year-old preschool children in a high fluoride zone [of a rural area of Shehezi in Xinjiang Province, China] and 83 similarly-aged children from a low fluoride zone in the same region. The results show that a high fluoride intake has a clear influence on the IQ of preschool children, manifesting itself primarily as damage to performance intelligence. The study also indicates that the proportion of preschool children living in the high fluoride area that have retarded head development (based on measurement of the circumference) is significantly greater than in the low fluoride control group, and that children with this developmental deficiency demonstrate a lower IQ than children with normal head development. The results in Table 1 show that not only is the proportion of children from high fluoride zones with IQs less than 90 higher than in those from the control area, but the average IQ is significantly lower. Statistically, the difference is very significant, which demonstrates that living in high fluoride areas for a long period of time and the corresponding high intake of fluoride has a definite effect of the intellectual development of the child.

Link: http://www.fluorideresearch.org/414/files/FJ2008_v41_n4_p340-343.pdf

Effect of fluoride exposure on intelligence in children

XS Li, JL Zhi and R0 Gao

Summary

The intelligence was measured of 907 children aged 8-13 years living in areas which differed in the amount of fluoride present in the environment. The Intelligence Quotient (IQ) of children living in areas with a medium or severe prevalence of fluorosis was lower than that of children living in areas with only slight fluorosis or no fluorosis. The development of intelligence appeared to be adversely affected by fluoride in the areas with a medium or severe prevalence of fluorosis but to a minor extent only in areas with only a slight prevalence of fluorosis. A high fluoride intake was associated with a lower intelligenoe. No correlation was found between age and intelligence in the areas with a medium and severe prevalence of fluorosis. The effect of exposure to a high level of fluoride on intelligence may occur at an early stage of development of the embryo and infant when the differentiation of brain nerve cells is occurring and development is most rapid.

Link: http://www.fluoridealert.org/wp-content/uploads/li-1995.pdf

The Effect of Fluoride on the Level of Intelligence in Children

XU, Yaoling, LU, Chunsheng, ZHANG, Xining
The Provincial Research Institute for Prevention against Diseases of Shandong Province, Jinan, China

Abstract

Results of IQ testing: The number of children whose level of intelligence is lower is significantly increased in regions of high fluoride/iodine, regions of high fluoride only, regions of high fluoride/low iodine, against their respective comparative groups. Little difference was detected in the results of high fluoride/iodine regions and regions where only a high amount of fluoride is detected. However, the results in these aforementioned regions in comparison against regions of high fluoride/ low iodine are significantly different. This could be demonstrative of the fact that fluoride acts to increase the toxicity and worsen the occurrence of thyroid swelling.

Link: http://www.fluoridealert.org/wp-content/uploads/xu-1994.pdf

Effects of high fluoride intake on child mental work capacity: preliminary investigation into the mechanisms involved

Yun Li,a Xiaoji Li,a Siqiong Weia
Chengdu, Sichuan, China

Summary

A study was carried out on 157 children, age 12–13, from a coal-burning fluorosis endemic area together with an experiment looking into the effect of high fluoride intake in animals. The results showed that early, prolonged high fluoride intake causes a decrease in a child's mental work capacity and that prolonged high uptake of fluoride causes a child's levels of hair zinc to drop. A multifactoral correlative analysis demonstrated a direct correlation between hair zinc and mental work capacity. The decrease of 5-hydroxyindoleacetic acid and the increase of norepinephrine in animal brains exposed to high levels of fluoride suggest a possible mechanism for mental work capacity deficits in children.

Link: http://www.fluoridealert.org/wp-content/uploads/li-1994.pdf

The effects of high levels of fluoride and iodine on child intellectual ability and the metabolism of fluoride and iodine

Yingkui Yang, Xiuhong Wang, Xiaowei Guo, Peiying Hua Jinan, China

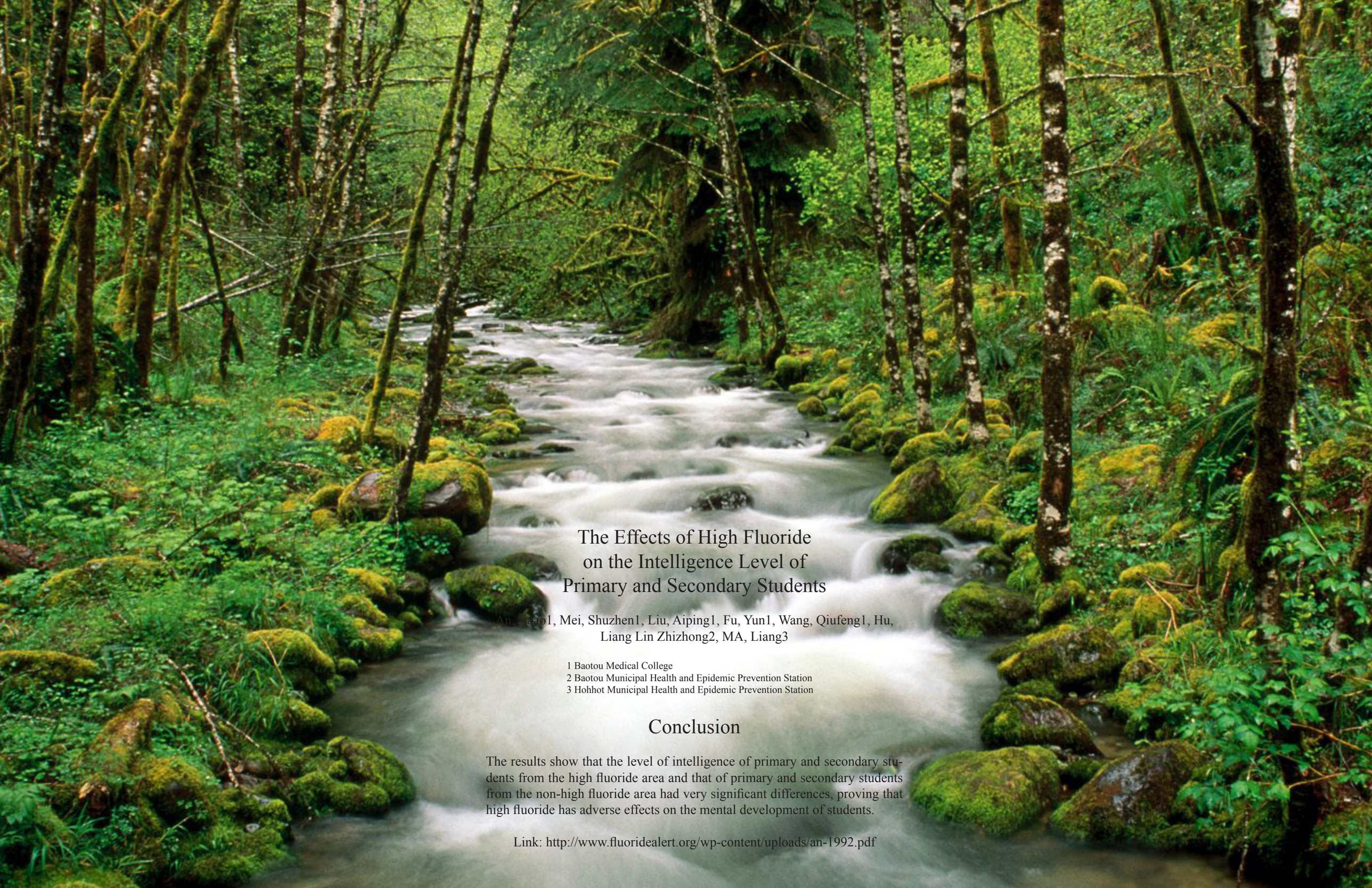
Abstract

Summary: The authors carried out a study on the intellectual abilities and fluoride/iodine metabolism of children living in a high fluoride-high iodine area. Among the results: the percentage of the general population living in this fluoride/iodine contaminated region that suffered from goiter (clinical thyroid enlargement) was 3.8%, the rate of children already showing some thyroid enlargement was 29.80%. Similarly, the rate of dental fluorosis for the general population was 35.48%, while for children it was 72.98%. Student subjects had average IQs of 76.67±7.75, with 16.67% of the IQs in the "low" category. The iodine content and fluoride content of the children's urine were 816.25±1.80 µg/L and 2.08±1.08 mg/L, respectively, significantly higher than the control. The thyroid glands of the subjects showed a markedly lower uptake rate of iodine-131 when compared with the control, the values after 3 hr and 24 hr were 9.36±1.55% and 9.26±4.63%, respectively, and the blood serum levels of thyroid stimulating hormone (TSH) were significantly higher than the control. The results indicate that high levels of fluoride and iodine have a serious damaging effect on the body, and should be given greater attention.

Conclusion

This suggests that the separate harm caused by an excess of each of the two elements is compounded when iodine and fluoride occur together in a single region, with their ingestion leading to a serious array of health problems. An excess of fluoride and a lack of iodine in the same environment has been shown to have a marked effect on child intellectual development, causing a more significant intellectual deficit than lack of iodine alone.

Link: http://www.fluoridealert.org/wp-content/uploads/yang-1994.pdf



The Effects of High Fluoride on the Intelligence Level of Primary and Secondary Students

An, Jiaao1, Mei, Shuzhen1, Liu, Aiping1, Fu, Yun1, Wang, Qiufeng1, Hu, Liang Lin Zhizhong2, MA, Liang3

1 Baotou Medical College
2 Baotou Municipal Health and Epidemic Prevention Station
3 Hohhot Municipal Health and Epidemic Prevention Station

Conclusion

The results show that the level of intelligence of primary and secondary students from the high fluoride area and that of primary and secondary students from the non-high fluoride area had very significant differences, proving that high fluoride has adverse effects on the mental development of students.

Link: http://www.fluoridealert.org/wp-content/uploads/an-1992.pdf

The relationship of a low-iodine and high fluoride environment to subclinical cretinism in Xinjiang

Institute for Endemic Disease Control and Researeh; Office of Leading Group for Endemic Disease Control of Hetian Prefectural Commitlee of the Communist Party of China; and County Health and Epidemic Prevention Station, Yutian, Xinjiang.

Conclusion

One hundred and four children with mental retardation were detected in all. Area A had 25%, area B 16%, and area C 8%. The significant differences in IQ among these regions suggests that fluoride can exacerbate central nervous lesions and somatic developmental disturbance caused by iodine deficiency. This may be in keeping with fluoride's known ability to cause degenerative changes in central nervous system cells and to inhibit the activities of many enzymes, including choline enzymes, causing disturbance of the nerve impulse. We found significant differences among the three areas, indicating that lack of iodine in children results in disturbance of the process of growth and ossification and that high fluoride intake can further disturb bone development. Also, the auditory threshold was significantly different among the three areas, with severe loss of hearing in high fluoride and low iodine areas. Severe iodine deficiency in early fetal life has adverse effects on the development and differentiation of the acoustic organ and we suggest that high fluoride intake may also promote hearing loss.

Link: http://www.fluoridealert.org/wp-content/uploads/lin-1991.pdf

Using Drawing Tests to Measure Intelligence in Children from Areas Impacted by Combined Al-F Endemic Toxicosis

Sun, Mingming1, Li, Shiguang1, Wang, Yanfang1, Li, Fucheng2

1 Department of Pediatrics, Guiyang Medical College
2 Epidemic Prevention Station of Liupanshui City

Abstract

Measurements of intelligence via drawing tests have been conducted to examine the intelligence development of children from regions affected by combined AI-F endemic toxicosis. A selected number of 196 children between 6.5 and 12 years of age participated in the testing. Across all age groups, the average IQ level of children from the endemic zones was lower than their counterparts in the non-endemic region. With the exception of the ≤7-year-old age group, significant differences in intelligence were found across all age groups when comparing the results between the endemic and the non-endemic group. From these results, it can be concluded that excessive consumption of fluorine and aluminum in the early stage of development directly impacts the development of the human brain, which causes the delayed intellectual development seen in children living in the endemic areas.

Link:
http://www.fluoridealert.org/wp-content/uploads/sun-1991.pdf

A study of the intellectual ability of 8-14 year-old children in high fluoride, low iodine areas

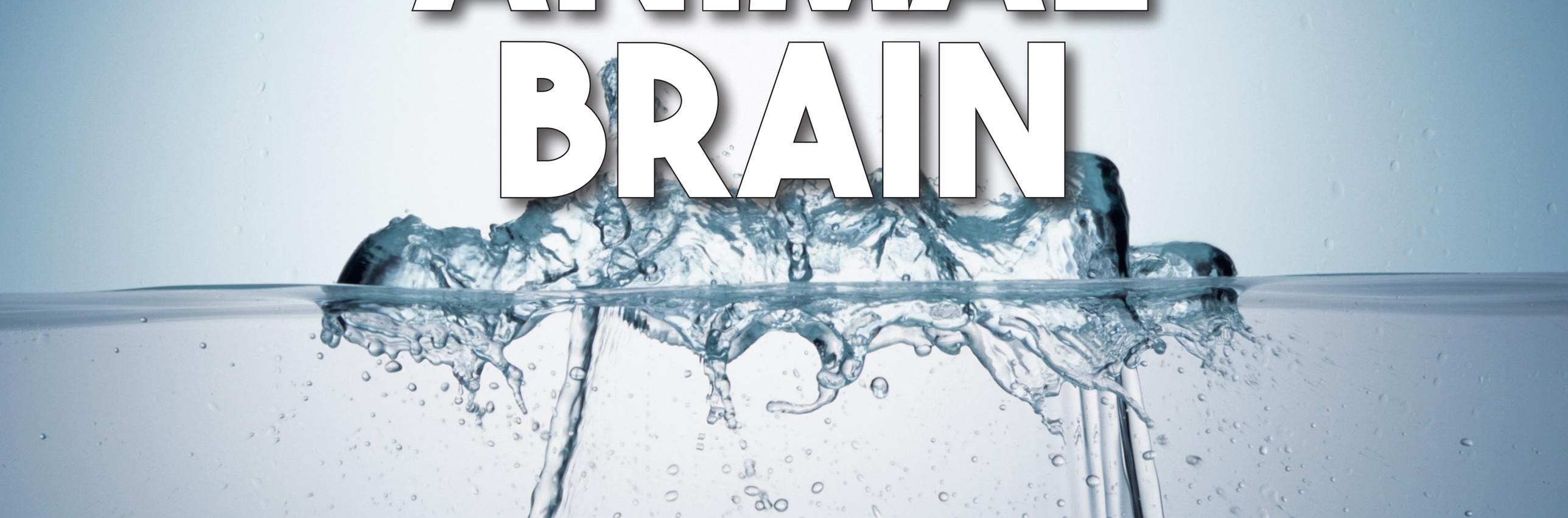
by Dali Ren, Kecheng Li, Dawei Liu

Summary

Wechsler Intelligence Test IQ scores of 160 children, 8–14 years old, from nine schools in an area of high fluoride and low iodine averaged 64.8 compared with 85.0 ($p<0.01$) for 169 children of the same ages from seven schools in an area with low iodine only. Among the first group 65 (40.6%) had IQs below 60, but only 23 (13.6%) among the second group had scores this low. In each group the IQs of the boys and girls did not differ significant. Clearly, exposure to the combination of high fluoride and low iodine was more deleterious than to low iodine alone.

Link: http://www.fluoridealert.org/wp-content/uploads/ren-1989.pdf

FLUORIDE AND THE ANIMAL BRAIN



Fluoride's Direct Effects On The Brains Of Animals

The possibility that fluoride ingestion may impair intelligence and other indices of neurological function is supported by research on the human fetal brain as well as a vast body of animal research. The animal research includes 15 laboratory experiments that have found impairments in learning and memory capacity among fluoride-treated animals. The animal research also includes over 40 studies that have investigated fluoride's impact on various parameters of brain quality. As discussed by the National Research Council, the studies have consistently demonstrated that fluoride, at widely varying concentrations, is toxic to the brain.

As highlighted in the excerpts below are common brain effects from fluoride exposure include:

- reduction in nicotinic receptors
- reduction in protein content
- alterations in protein expression
- damage to the hippocampus
- inhibition of cholinesterase activities
- increase in oxidative stress and
- neuronal degeneration

Other important findings from these animal studies include:

- fluoride's toxic effects on brain cells are significantly worse in the presence of iodine deficiency, a finding consistent with current research on human intelligence, and aluminum excess

- fluoride's effects are reduced by increased intake of anti-oxidants

Fluoride's effect on animal brains is found on the following pages

Uncontested, Published, Peer Reviewed Studies and Reports

"Excessive intake of fluoride results in an altered mitochondrial distribution in axon and soma in cortical neurons (i.e., the increase in soma and the decrease in axon), increased expression of Fis1 gene and enhanced mitochondrial fission. The altered mitochondrial distribution may be related to the high expression level of Fis1 and a functional disorder of mitochondria."

Source: Lou DD, et al. (2012). [Alteration of mitochondrial distribution and gene expression of fission 1 protein in cortical neurons of rats with chronic fluorosis]. [Article in Chinese]. Zhonghua Bing Li Xue Za Zhi. 41(4):243-7.

"The results showed that NaF impairs open-field habituation and increases noradrenaline (NA) and serotonin (5-HT) in the striatum, hippocampus and neocortex. Dopamine (DA) increase was restricted to the striatum. Short-term NaF withdrawal did not reverse these NaF-induced changes, and both NaF treatments led to a mild fluorosis in rat incisors."

Source: Pereira M, et al. (2011). Memory impairment induced by sodium fluoride is associated with changes in brain monoamine levels. Neurotox Res. 19(1):55-62.

"Presence of eosinophilic Purkinje cells, degenerating neurons, decreased granular cells, and vacuolations were noted in discrete brain regions of the fluoride-treated group. . . . The alterations were more profound in the third generation when compared with the first- and second-generation fluoride-treated group."

Source: Basha PM, et al. (2011). Fluoride toxicity and status of serum thyroid hormones, brain histopathology, and learning memory in rats: a multigenerational assessment. Biol Trace Elem Res. 144(1-3):1083-94.

"Results showed that the fluidity of brain synaptic membrane decreased gradually with increasing of fluoride concentration, and it was significantly decreased ($P < 0.05$) in moderate-fluoride group compared with control group, and expression level of PSD-95 was significantly decreased ($P < 0.01$) in moderate-fluoride group when compared with that of control group. These results indicate that decrease of synaptic membrane fluidity and PSD-95 expression level may be the molecular basis of central nervous system damage caused by fluoride intoxication; PSD-95 in CA3 region of hippocampus is probably a target molecule for fluoride."

Source: Zhu W, et al. (2011). Effects of fluoride on synaptic membrane fluidity and PSD-95 expression level in rat hippocampus. Biol Trace Elem Res. 139(2):197-203. "The results indicated that exposure to excessive fluoride resulted in the increase of apoptosis in rat brains and SH-SY5Y cells, in which one of the mechanisms might be activating JNK phosphorylation."

Source: Liu YJ, et al. (2011). Increased level of apoptosis in rat brains and SH-SY5Y cells exposed to excessive fluoride–a mechanism connected with activating JNK phosphorylation. Toxicol Lett. 204(2-3):183-9.

"The present paper identifies different expressed proteins in the brains of rats under the treatment of high fluoride, low iodine, and both together compared to controls, in order to better understand the changes in functional proteins to gain insight into the mechanisms of high fluoride and low iodine. The proteins that were found to be significantly regulated (up-regulated and down-regulated) included guanine nucleotide-binding proteins (G proteins), synaptotagmin I, lactate dehydrogenase A (LDHA), proteosome, and adenylosuccinate lyase (ASL). Some of these proteins were previously reported to be related to fluorosis and iodine deficiency diseases (IDD). These proteins are involved in the regulation of a number of important cellular functions like cellular signaling, energy metabolism, and protein metabolism."

Source: Ge Y, et al. (2011). Proteomic analysis of brain proteins of rats exposed to high fluoride and low iodine. Arch. Toxicol. 85:27-33.

"The data indicates significant alterations in the parameters related to haeme synthesis pathway like inhibition of blood delta-aminolevulinic acid dehydratase, delta-aminolevulinic acid synthetase, oxidative stress like depletion of glutathione (GSH) and increase in oxidized glutathione (GSSG) and thiobarbituric acid reactive substances. These changes were accompanied by depletion in GSH:GSSG ratio, whole brain biogenic amine levels and a dose-dependent increase in fluoride concentration. Interestingly and most significantly, these changes were more pronounced at lower concentrations of fluoride compared with higher fluoride dose. Biochemical changes were supported by the histological observations, which also revealed that at high concentrations of fluoride, toxic effects and damages to organs were more pronounced."

Source: Chouhan S, et al. (2010). Fluoride-induced changes in haem biosynthesis pathway, neurological variables and tissue histopathology of rats. J Appl Toxicol. 30(1):63-73.

"The results showed that in the rat offspring exposed to higher fluoride as compared to controls, the learning and memory ability declined; the cholinesterase activities in the brains were inhibited; the protein levels of alpha3, alpha4 and alpha7 nAChR subunits were decreased which showed certain significant correlations with the declined learning and memory ability; and the mRNA levels of alpha3 and alpha4 nAChRs were decreased, whereas the alpha7 mRNA increased."

Source: Gui CZ, et al. (2010). Changes of learning and memory ability and brain nicotinic receptors of rat offspring with coal burning fluorosis. Neurotoxicol Teratol. 32(5):536-41.

"The results showed that as compared with controls, the learning and memory capacity in the rats with fluorosis was decreased. The protein expressions of alpha7 and alpha4 nAChR subunits in rat brains with fluorosis were decreased by 35% and 33%, whereas the corresponding receptor subunit mRNAs did not exhibit any changes. The increases of phospho- and total-ERK1/2 as well as phospho-MEK1/2 at the protein levels were found in the brains of rats with fluorosis as compared to controls, and no difference of ERK1/2 mRNA was found. In addition, the activation rate of phospho-ERK1/2 was decreased in the brains affected with fluorosis. The modifications of nAChRs and ERK1/2 pathway might be connected with the molecular mechanisms in the decreased capacity of learning and memory of the rats with fluorosis."

Source: Liu YJ, et al. (2010). Alterations of nAChRs and ERK1/2 in the brains of rats with chronic fluorosis and their connections with the decreased capacity of learning and memory. Toxicol Lett. 192(3):324-9.

"Following fluoride exposure, oxidative stress increased significantly, estimated by increased lipid peroxidation and a decrease in the activity of the antioxidant enzyme, superoxide dismutase. The neurotransmitter (e.g., dopamine, norepinephrine, and serotonin) content was also altered. However, these aspects were more pronounced in animals given fluoride and aluminum together. Histological evidence showed deprival of neuronal integrity with higher magnitude in concurrent fluoride and aluminum exposure, as compared to fluoride alone. Thus, it can be concluded that aluminum appears to enhance the neurotoxic hazards caused by fluoride."

Source: Kaur T, et al. (2009). Effect of concurrent chronic exposure of fluoride and aluminum on rat brain. Drug & Chem. Toxicol. 32(3): 215-21.

"Fluoride (F) and lead (Pb) are two common environmental pollutants which are linked to the lowered intelligence, especially for children. Glutamate, a major excitatory neurotransmitter in the central nervous system, plays an important role in the process of learning and memory. However, the impact of F and Pb alone or in combination on glutamate metabolism in brain is little known. The present study was conducted to assess the glutamate level and the activities of glutamate metabolism related enzymes including asparate aminotransferase (AST), alanine aminotransferase (ALT) and glutamic acid decarboxylase (GAD) in the hippocampus, as well as learning abilities of offspring rat pups at postnatal week 6, 8, 10 and 12 exposed to F and/or Pb. . . . Results showed that the learning abilities and hippocampus glutamate levels were significantly decreased by F and Pb individually and the combined interaction of F and Pb. The activities of AST and ALT in treatment groups were significantly inhibited, while the activities of GAD were increased, especially in rats exposed to both F and Pb together. These findings suggested that alteration of hippocampus glutamate by F and/or Pb may in part reduce learning ability in rats."

Source: Niu R, et al. (2009). Decreased learning ability and low hippocampus glutamate in offspring rats exposed to fluoride and lead. Environ Toxicol Pharmacol. 28(2):254-8.

“Exposure to arsenic and fluoride significantly decreased the levels of brain biogenic amines. However; acetyl cholinesterase (AChE) and monoamine oxidase (MAO) activities showed an increase on fluoride exposure. There was also an increase in reactive oxygen species, thiobarbituric acid reactive species level, glutathione S-transferase and glutathione peroxidase activities and decreased superoxide dismutase activity, GSH:GSSG ratio, glucose 6-phosphate dehydrogenase activity. Combined exposure to these toxicants produced more pronounced effects on AChE, MAO, SOD and catalase activities. Infrared spectra showed less toxicity during combined exposure as the characteristic peaks of cytosine and alpha-helical structure of DNA were observed in normal and arsenic plusfluoride-exposed animals. Vitamin E reduced brain fluoride level and tissue oxidative stress but had no effect on arsenic. Combined exposure to arsenic and fluoride does not necessarily lead to more pronounced toxicity and interestingly exhibit some antagonistic effects. Vitamin E supplementation may be of added value in reverting some of the toxic effects.”

Source: Flora SJ, et al. (2009). Co-exposure to arsenic and fluoride on oxidative stress, glutathione linked enzymes, biogenic amines and DNA damage in mouse brain. J Neurol Sci. 285(1-2):198-205.

“This study reports the protective effects of selenium on fluoride induced alterations in the activities of pro-oxidative (xanthine oxidase (XOD), lipid peroxidation (LPO) free radical scavenging, [catalase, superoxide dismutase (SOD), glutathione-s-transferase (GST), glutathione peroxidase (GPX), glutathione reductase (GR), glutathione) and metabolic (glucose-6-phosphate dehydrogenase, alanine amino transferase (ALAT), aspartate aminotransferase (AAT), creatine phosphokinase (CPK), acid phosphatase (AP), alkaline phosphatase (ALP)] enzymes along with fluoride and selenium levels in brain of mice. . . . As evident in this study the antioxidative nature of selenium coupled with its reversal effect on metabolic enzymes in brain of mice treated with fluoride suggests its use as antidote agent against fluorosis.”

Source: Reddy KP, et al. (2009). Protective effects of selenium on fluoride induced alterations in certain enzymes in brain of mice. J Environ Biol. 30(5 Suppl):859-64.

“Total protein showed a concentration dependent decrease in brain and muscles but an increase in liver. The results of the study indicate that elevated fluoride in drinking water affects not only mammalian neurotransmitter functions but also antioxidant systems.”

Source: Bhatnagar M, et al. (2006). Biochemical changes in brain and other tissues of young adult female mice from fluoride in their drinking water. Fluoride 39(4):280-84.

"In this study, the percentage of damaged brain cells of grades II and III was up to 12% higher than in the control group, and the ratio of tailing was 24.68%. DNA damage of brain cells exposed to high fluoride, low iodine, and their combined interaction markedly increased, especially in the High Fluoride plus Low Iodine group."

Source: Ge Y, et al. (2005). Comet assay of DNA damage in brain cells of adult rats exposed to high fluoride and low iodine. Fluoride 38:209-14.

"In the present study, levels of glutathione and activities of catalase, GSH-PX, and SOD were significantly decreased, whereas lipid peroxide levels were enhanced in the brain of adult rats by treatment with NaF, As2O, or NaF + As2O3, in agreement with earlier reports."

Source: Chinoy NJ, et al. (2004). Biochemical effects of sodium fluoride and arsenic trioxide toxicity and their reversal in the brain of mice. Fluoride 37: 80-87.

“The histology of the cerebral hemisphere was altered by NaF and/or Arsenic trioxide [As2O3] treatment for 30 days, wherein the effect by As2O3 was greater than by NaF treatment. This result is in agreement with others. The reduced brain acetylcholinesterase (AChE) enzyme activity observed in the present study corroborates data of others in rats exposed for three months to arsenic trioxide and in the brain of NaF-treated mice and rats as compared to controls. The DNA and RNA levels in the cerebral hemisphere were significantly lower in NaF and/or As2O3-treated mice in the present study, which could affect brain function. The ingestion of the antidotes vitimans C and E as well as calcium phosphate, either indivdually or in combination, during the 30-day withdrawal period resulted in significant recovery, probably due to the antioxidant-properties of vitamins C and E and modulation of fluoride-induced toxicity in rats by calcium.”

Source: Shah SD, Chinoy NJ. (2004). Adverse effects of fluoride and/or arsenic on the cerebral hemisphere of mice and recovery by some antidotes. Fluoride 37: 162-171.

“Superoxide dismutase (SOD) activity and the malondialdehyde (MDA) content in the brain of the combined high fluoride and low iodine group were significantly higher during and at the end of the 90-day period than in the control group, but the SOD/MDA ratio in this high fluoride and low iodine group was consistently lower than in the control group. These results suggest that [oxidative] stress from high fluoride and low iodine is one of the causes of reduction in learning and memory in offspring rats.”

Source: Wang J, Ge Y, Ning H, Wang S. (2004). Effects of high fluoride and low iodine on biochemical indexes of the brain and learning-memory of offspring rats. Fluoride 37: 201-208.

“Brain protein was decreased by low iodine and even more by the combined interaction of high fluoride and low iodine. The activity of cholinesterase (ChE) in the brain was affected to some extent by high fluoride and low iodine but was especially affected by high fluoride and low iodine together.”

Source: Wang J, et al. (2004). Effects of high fluoride and low iodine on biochemical indexes of the brain and learning-memory of offspring rats. Fluoride 37: 201-208.

“Recently, we have detected the alterations of nicotinic acetylcholine receptors (nAChRs) in rat brains and PC12 cells affected by fluoride toxicity… [O]xidative stress, including protein oxidation of the receptors and lipid peroxidation in cellular membrane, might be a mechanism of the deficit of the receptors.”

Source: Shan KR, Qi XL, Long YG, Wang YN, Nordberg A, Guan ZZ. (2004). Decreased nicotinic receptors in PC12 cells and rat brains influenced by fluoride toxicity—a mechanism relating to a damage at the level in post-transcription of the receptor genes. Toxicology 200: 169–177.

“Fluorosis had obvious influence on phospholipid and fatty acid composition in brain cells of rats, and its mechanism might be associated with action of lipid peroxidation, and 0.03 mg/L KI (potassium iodine) is the optimal concentration for the antagonistic action with this influence from fluorosis.”

Source: Shen X, Zhang Z, Xu X. (2004). [Influence of combined iodine and fluoride on phospholipid and fatty acid composition in brain cells of rats] Wei Sheng Yan Jiu. 33:158-61.

“These findings suggest that selective decreases in the number of nAChRs may play an important

role in the mechanism(s) by which fluoride causes dysfunction of the central nervous system."

Source: Chen J, Shan KR, Long YG, Wang YN, Nordberg A, Guan ZZ. (2003). Selective decreases of nicotinic acetylcholine receptors in PC12 cells exposed to fluoride. Toxicology 183: 235-42.

"Neuropathological changes occurred with loss of the molecular layer and glial cell layer in the brain tissues of rabbits exposed to the three higher fluoride doses. The Purkinje neurones exhibited chromatolysis and acquired a "ballooned" appearance. Nissl substance showed various degrees of decrease and even complete loss. Fragmented particles were retained in the perinuclear zone. The perikaryon showed vacuolization, and spheroid bodies were present in the neoplasm. These cytoplasmic inclusions appeared as various sized ovoid bodies or elongated eosinophilic masses due to which the nucleus was shifted to the periphery. These neurotoxic changes in the brain suggested that there was a direct action of fluoride upon the nerve tissue which was responsible for central nervous system problems such as tremors, seizures, and paralysis indicating brain dysfunction seen at the two highest doses."

Source: Shashi A. (2003). Histopathological investigation of fluoride-induced neurotoxicity in rabbits. Fluoride 36: 95-105.

"Fluoride may go through the blood-brain barrier and accumulate in rat hippocampus, and inhibit the activity of cholinesterase."

Source: Zhai JX, et al. (2003). [Studies on fluoride concentration and cholinesterase activity in rat hippocampus]. Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi 21:102-4.

"Light microscopic study of hippocampal sub-regions demonstrated significant number of degenerated nerve cell bodies in the CA3, CA4 and dentate gyrus(Dg) areas of sodium fluoride administered adult female mice. Ultrastructural studies revealed neurodegenerative characteristics like involution of cell membranes, swelling of mitochondria, clumping of chromatin material etc, can be observed in cell bodies of CA3, CA4 and dentate gyrus (Dg)."

Source: Bhatnagar M, et al. (2002). Neurotoxicity of fluoride: neurodegeneration in hippocampus of female mice. Indian Journal of Experimental Biology 40: 546-54.

"The DNA damage in pallium neurons in rats of the fluoride group was much more serious compared with those of the control group…Sodium fluoride could induce DNA damage and apoptosis in rats brain."

Source: Chen J, Chen X, Yang K, Xia T, Xie H. (2002). [Studies on DNA damage and apoptosis in rat brain induced by fluoride]. Zhonghua Yu Fang Yi Xue Za Zhi 36: 222-224.

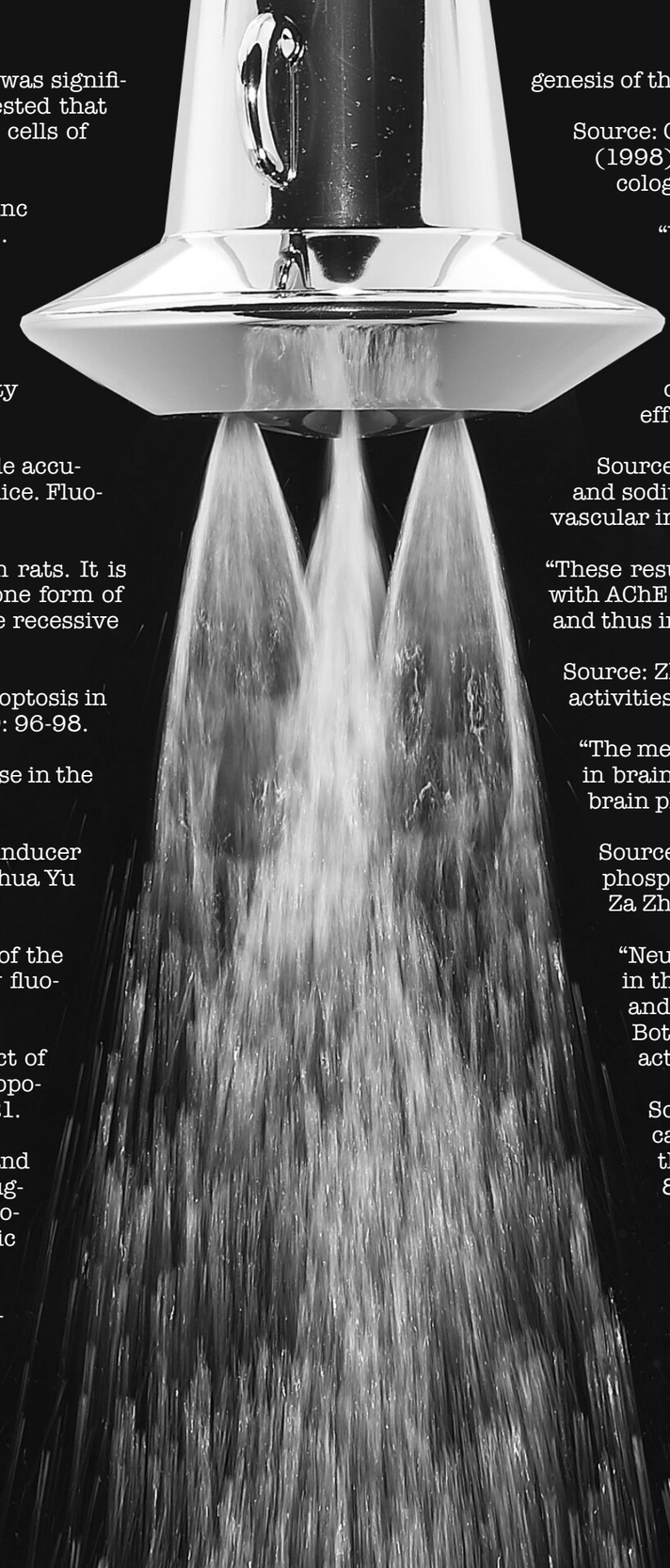
"In order to investigate the molecular mechanism(s) underlying brain dysfunction caused by chronic fluorosis, neuronal nicotinic acetylcholine receptors (nAChRs) in the brain of rats receiving either 30 or 100 ppm fluoride in their drinking water for 7 months were analyzed in the present study employing ligand binding and Western blotting… Since nAChRs play major roles in cognitive processes such as learning and memory, the decrease in the number of nAChRs caused by fluoride toxicity may be an important factor in the mechanism of brain dysfunction in the disorder."

Source: Long YG, Wang YN, Chen J, Jiang SF, Nordberg A, Guan ZZ. (2002). Chronic fluoride toxicity decreases the number of nicotinic acetylcholine receptors in rat brain. Neurotoxicology and Teratology 24:751-7.
"These results suggest that fluoride enhances oxidative stress in the brain, thereby disturbing the antioxidant defense of rats. Increased oxidative stress could be one of the mediating factors in the pathogenesis of fluoride toxicity in the brain."

Source: Shivarajashankara YM , et al. (2002). Brain lipid peroxidation and antioxidant systems of young rats in chronic fluoride intoxication. Fluoride 35: 197-203.

"rats exposed to 100 ppm fluoride showed significant neurodegenerative changes in the hippocampus, amygdala, motor cortex, and cerebellum… These histological changes suggest a toxic effect of high-fluoride intake during the early developing stages of life on the growth, differentiation, and subcellular organization of brain cells in rats."

Source: Shivarajashankara YM , et al. (2002). Histological changes in the brain of young fluoride-intoxicated rats. Fluoride 35: 12-21.



"The extent of DNA damage in the fluoride + selenium + zinc group was significantly slighter than that in the fluoride group ($P < 0.05$). It suggested that fluoride and selenium could induce DNA damage in pallium neural cells of rats respectively."

Source: Chen J, Chen X, Yang K. (2000). [Effects of selenium and zinc on the DNA damage caused by fluoride in pallium neural cells of rats]. Wei Sheng Yan Jiu. 29: 216-7.

"This study therefore shows that both brain and muscle are affected by fluoride with inhibition of some enzymes associated with free-radical metabolism, energy production and transfer, membrane transport, and synaptic transmission, but with an enhanced activity of XOD."

Source: Lakshmi Vani M, Pratap Reddy K. (2000). Effects of fluoride accumulation on some enzymes of brain and gastrocnemius muscle of mice. Fluoride 33: 17-26.

"There is a tendency for neurone apoptosis in chronic fluorosis in rats. It is most evident with changes in pathology. It is not likely that only one form of neurone damage exist in the process of chronic fluorosis. There are recessive changes and apoptosis in the process at the same time."

Source: Lu XH, et al. (2000). Study of the mechanism of neurone apoptosis in rats from the chronic fluorosis. Chinese Journal of Epidemiology 19: 96-98.

"Over uptake of fluoride for a long term could cause potential increase in the level of oxidative stress in the brain tissue."

Source: Shao Q, Wang Y, Guan Z. (2000). [Influence of free radical inducer on the level of oxidative stress in brain of rats with fluorosis]. Zhonghua Yu Fang Yi Xue Za Zhi 34:330-2.

"It was concluded that aluminium interferes with the metabolism of the neuronal cytoskeleton and that this interference is potentiated by fluoride."

Source: van der Voet GB, et al. (1999). Fluoride enhances the effect of aluminium chloride on interconnections between aggregates of hippocampal neurons. Archives of Physiology and Biochemistry 107:15-21.

"[T]he thickness of post-synaptic density (PSD) was decreased, and the width of synaptic cleft was remarkably increased. The results suggested that the impairment on the learning capability induced by fluorosis may be closely related with the pathological changes of synaptic structure in the brain of mice."

Source: Zhang Z, et al. (1999). [Effect of fluoride exposure on synaptic structure of brain areas related to learning-memory in mice] [Article in Chinese]. Wei Sheng Yan Jiu 28:210-2.

"The results demonstrate that the contents of phospholipid and ubiquinone are modified in brains affected by chronic fluorosis and these changes of membrane lipids could be involved in the pathogenesis of this disease."

Source: Guan ZZ, Wang YN, Xiao KQ, Dai DY, Chen YH, Liu JL, Sindelar P, Dallner G. (1998). Influence of chronic fluorosis on membrane lipids in rat brain. Neurotoxicology and Teratology 20: 537-542.

"While the small amount of AlF in the drinking water of rats required for neurotoxic effects is surprising, perhaps even more surprising are the neurotoxic results of NaF at the dose given in the present study [1.0 ppm F]... The results of the present study indicate that more intensive neuropathological evaluations of F effects on brain may prove to be of value... In summary, chronic administration of AlF and NaF in the drinking water of rats resulted in distinct morphological alterations in the brain, including effects on neurons and cerebrovasculature."

Source: Varner JA, et al. (1998). Chronic administration of aluminum-fluoride and sodium-fluoride to rats in drinking water: Alterations in neuronal and cerebrovascular integrity. Brain Research 784: 284-298.

"These results indicate that fluoride may penetrate the blood brain barrier, interact with AChE located on cell membranes, and interfere with their physiological functions and thus induce the neurotoxicities."

Source: Zhao XL, Wu JH. (1998). Actions of sodium fluoride on acetylcholinesterase activities in rats. Biomedical and Environmental Sciences 11(1):1-6.

"The metabolism of brain phospholipid might be interfered by fluoride accumulated in brain tissue, which is related with the degeneration of neuron. The changes of brain phospholipid could be involved in the pathogenesis of chronic fluorosis."

Source: Guan Z, Wang Y, Xiao K. (1997). [Influence of experimental fluorosis on phospholipid content and fatty acid composition in rat brain]. Zhonghua Yi Xue Za Zhi. 77: 592-6.

"Neuronal abnormalities were observed in the NaF treated animals- especially in the deeper cell layers... The NaF treatment also produced distortions of cells and, in some rats, cell losses could be demonstrated in particular brain regions. Both AlF3 and NaF induced vascular inclusions, although of a different character..."

Source: Issacson R, et al. (1997). Toxin-induced blood vessel inclusions caused by the chronic administration of aluminum and sodium fluoride and their implications for dementia. Annals of the New York Academy of Science 825: 152-166.

"Coenzyme Q content of brain tissue in rats fed with fluorine-containing water decreased at early stage of fluorosis, but increased significantly at late stage. It is speculated that changes in content of coenzyme Q could correlate with changes in free radical levels induced by fluorine."

Source: Wang Y, Guan Z, Xiao K. (1997). [Changes of coenzyme Q content in brain tissues of rats with fluorosis]. Zhonghua Yu Fang Yi Xue Za Zhi. 31: 330-3.

“Excessive fluoride intake decreased 5-hydroxy indole acetic acid and increased norepinephrine in rat brain.”

Source: Li Y, et al. (1994). [Effect of excessive fluoride intake on mental work capacity of children and a preliminary study of its mechanism] Hua Hsi I Ko Ta Hsueh Hsueh Pao. 25(2):188-91.

“The results reported here indicate that fluoride has a specific effect on the synthesis of proteins in the brain which may lead to degenerative changes in the form of ballooning degeneration of neurons, various degrees of loss of nisal substance, and changes in the purkinje cells of the cerebellar cortex. Such changes would provide a plausible explanation for some of the diverse neruological complaints in arms and legs such as numbness, muscle spasms and pains, tenaniform convulsions, and spastic paraplegia, encountered in patients with skeletal fluorosis.”

Source: Shashi A, et al. (1994). Effect of long-term administration of fluoride on levels of protein, free amino acids and RNA in rabbit brain. Fluoride 27: 155-159.

“The neurotoxic effect of fluoride on lipid content of brain was assessed in rabbits during experimental fluorosis… Fluoride exerts an inhibitory effect on the free fatty acids in brain of both sexes. The relevance of these results in experimental fluorosis is discussed.”

Source: Shashi A. (1992). Studies on alterations in brain lipid metabolism following experimental fluorosis. Fluoride 25:77-84.

FLUORIDES NEUROBEHAVIORAL EFFECTS ON HUMANS

In addition to studies linking fluoride to reduced IQ in humans, and impaired learning/memory in animals, human and animal studies have also linked fluoride to a variety of other neurobehavioral effects. These studies, which are excerpted below, provide yet further evidence that fluoride is a neurotoxin. The importance of considering other indices of fluoride neurotoxicity besides reduced IQ was recently discussed by a team of Mexican researchers. (Rocha-Amador 2009). As the researchers noted:

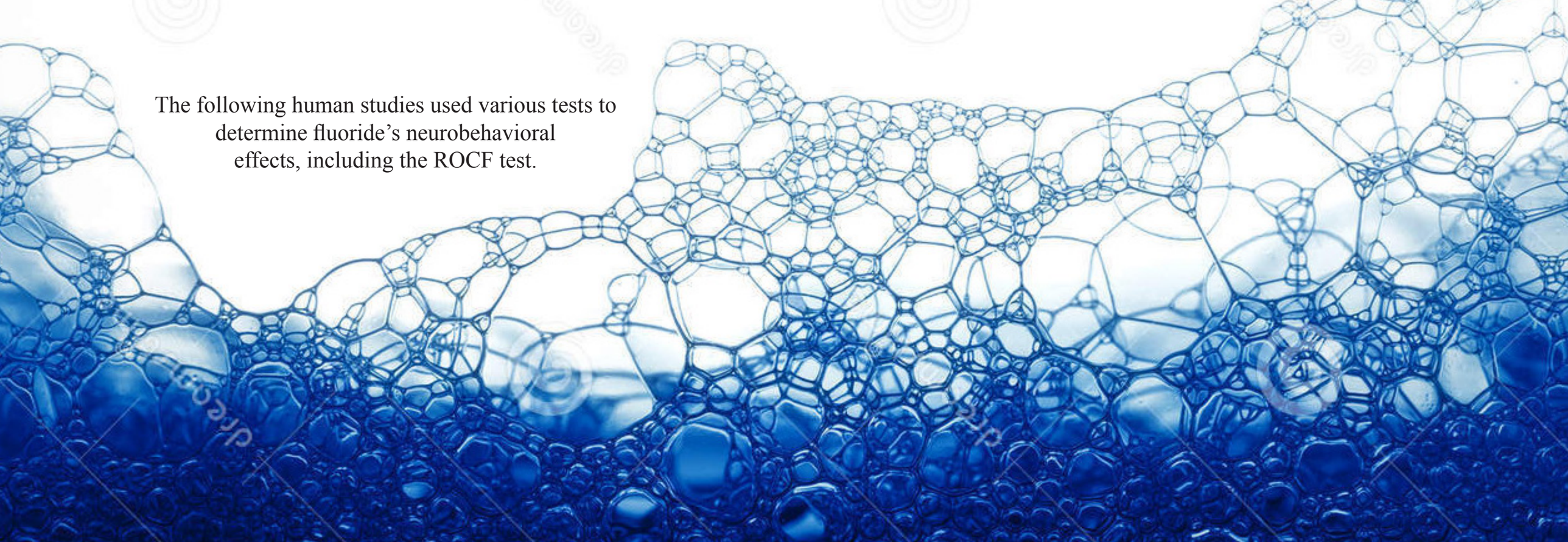
"Intuitively, though it might seem that an IQ test would be an ideal measure [for determining the neurotoxic effects of a chemical], this assumption would be ill founded, because some toxicants could affect only specific functions, such as attention, memory, language, or visuospatial abilities without clear decrements on IQ scores. Furthermore, the exposure dose as well as mixtures of toxicants are important factors that also need to be considered."

To help highlight this point, the researchers cited their earlier study which found that although fluoride did not affect overall IQ scores, it did affect reaction time and visual-spatial organization. (Calderon 2000).

To better understand fluoride's non-IQ effects on the brain, the Mexican team suggests using the Rey-Osterrieth Complex Figure (ROCF) Test:

"[I]t is imperative to have a tool for rapid risk assessment to quantitatively measure health effects. In neuropsychology there are several tests that can be used for this purpose but many of them have issues including lack of validation and standardized values for the Mexican population, furthermore the influence of cultural factors also limits their usefulness. These issues could be solved in part by the Rey-Osterrieth Complex Figure (ROCF) Test. This test is one of the most widely used in neuropsychology for the evaluation of visuo-spatial constructional ability and non-verbal memory skills in both clinical and research settings."

Source: Rocha-Amador, D. et al (2009). Use of the Rey-Osterrieth Complex Figure Test for neurotoxicity evaluation of mixtures in children. Neurotoxicology 30(6):1149-54



The following human studies used various tests to determine fluoride's neurobehavioral effects, including the ROCF test.

“In this cross-sectional study, the psychomotor performance and memory skills of a fluoride-exposed group (FEG) of 64 male workers in an aluminum potroom were compared with those of 60 male workers in a nonfluoride-exposed group (NFEG). The FEG had a mean age of 37.59±4.82 yr and had been employed for 13.06±4.29 yr, which compared closely with the NFEG. Both groups were selected randomly and had no previous history of neuropsychological, hepatic, renal, or immune disorders. The neurobehavioural functions were measured using the World Health Organization neurobehavioural core test battery (NCTB), a computer based test, for reaction time, and a Purdue pegboard test for manual dexterity and hand-eye coordination. The FEG had significant impairments compared to the NFEG for mean reaction time, Purdue pegboard for the preferred hand and both hands, pursuit aiming, digit span, Benton Visual Retention ($p<0.001$), and digit symbol memory ($p<0.01$). The digit symbol performance scores, but not those for the other parameters, decreased with increased work duration ($p<0.05$). Overall, the mechanism for the impairments did not appear to be the result of impaired thyroid function. We conclude that neurobehavioural testing is useful for detecting impairment of psychomotor performance and memory that associated with occupational F exposure.”

Source: Yazdi SM, et al. (2011). Effects of fluoride on psychomotor performance and memory of aluminum potroom workers. Fluoride 44:158-62.

“The objective of this study was to explore the potential usefulness of the ROCF [Rey-Osterrieth Complex Figure] test as a tool for a rapid assessment to evaluate visuospatial organization (Copy) and visual memory (Immediate Recall) in children living in areas of Mexico exposed to different mixtures of neurotoxic agents including [fluoride], [arsenic], [lead], DDT or PCBs.” RESULTS: “This study provides evidence that children living in high risk areas were exposed to either fluoride, arsenic, lead, DDT or PCBs and these contaminants could contribute, to some degree, to children’s low performance observed in the tests of the Rey-Osterrieth Complex Figure. The highest proportion of children (89%) with Copy performance below – 1 SD was observed in children from fluoride–arsenic area. Approximately 9 out of 10 children were unable to copy the ROCF as expected for their age. For example, the expected score on Copy for a 6-year-old child is 9.94 +- 2.28 points. A child classified in the category below -1 SD means that his score was lower than 7.66. In the fluoride–arsenic area children had z-scores as low as -5 SD (scoring only two points on the test). For Immediate Recall, the proportion of children in the lowest category was 59% and almost 6 out of 10 children were unable to draw the figure as expected for their age after 3 min had elapsed. Following the same example of a 6-year-old child, the expected value for drawing the figure from memory is 7.26 +- 2.45. One child classified in the –1 SD category had a score below 4.81 points. Fluoride correlated inversely with Copy and Immediate Recall r = _0.29 and r = _0.27 (adjusted values). Previous data have reported a similar association between Copy scores and [urinary fluoride] in children.”

Source: Rocha-Amador D, et al. (2009). Use of the Rey-Osterrieth Complex Figure Test for neurotoxicity evaluation of mixtures in children. Neurotoxicology 30(6):1149-54.

“There are numerous reports of mental and physiological changes after exposure to fluoride from various routes (air, food, and water) and for various time periods (Waldbott et al. 1978). A number of the reports are, in fact, experimental studies of one or more individuals who underwent withdrawal from their source of fluoride exposure and subsequent re-exposures under “blind” conditions. In most cases, the symptoms disappeared with the elimination of exposure to fluoride and returned when exposure was reinstated. In some instances, when the fluoride was given in water, this procedure was repeated several times under conditions in which neither the patient nor the provider of the fluoride knew whether the water contained fluoride. Also reported are instances when fluoride-produced symptoms occurred when people moved into a community with fluoridated water but disappeared when the individuals moved to a nonfluoridated community. Spittle (1994) reviewed surveys and case reports of individuals exposed occupationally or therapeutically to fluoride and concluded there was suggestive evidence that fluoride could be associated with cerebral impairment. A synopsis of 12 case reports of fluoride-exposed people of all ages showed common sequelae of lethargy, weakness, and impaired ability to concentrate regardless of the route of exposure. In half the cases, memory problems were also reported.”

Source: National Research Council. (2006). Fluoride in Drinking Water: A Scientific Review of EPA’s Standards. National Academies Press, Washington D.C. p. 208-09.

“The effects of excessive fluoride intake during pregnancy on neonatal neurobehavioral development and the neurodevelopment toxicity of fluoride were evaluated. Ninety-one normal neonates delivered at the department of obstetrics and gynecology in five hospitals of Zhaozhou County, Heilongjiang Province, China were randomly selected from December 2002 to January 2003. The subjects were divided into two groups (high fluoride and control) based on the fluoride content in the drinking water of the pregnant women. . . . There were significant differences in the neonatal behavioral neurological assessment score and neonatal behavioral score between the subjects in the endemic fluoride areas and the control group. . . . [N]eurobehavioural capability and agonistic muscle tension from the high fluoride group were impaired, resulting in a statistically significant lower overall (total) assessment score than in the control group ($p<0.05$). . . . [V]arious neurobehavioral capabilities, such as non-biological visual, biological visual, and auditory directional reactions of the neonates from the high fluoride group lagged behind those of the control group with differences that are statistically significant ($p<0.05$). . . . NBNA examination can help to detect mild damage to brain functions. The results of the examination indicate that high fluoride levels can cause adverse effects in the neurobehavioral development of neonates. . . . The present observations indicate that fluoride, as a toxic material to nerve development, can have an adverse impact on the neurobehavioral development of neonates and can cause abnormal changes of neurobehavioral capability during the neonate period with a negative impact on the future development of both the body and intelligence of the neonate. Therefore, in endemic fluoride areas, great effort should be made to reduce fluoride level in the water.”

Source: Li J, Yao L, Shao Q-L. (2004). Effects of high-fluoride on neonatal neurobehavioural development. Chinese Journal of Endemiology 23:464-465. (Republished in Fluoride 2008; 41:165-70).

“In recent years, the damage fluoride inflicts on nonskeletal organs, and in particular the nervous system, has received a great deal of attention. However, research on the effects of fluoride on neurobehavioral function (as measured by the neurobehavioral core test battery, or NCTB) is new to the literature. By relating NCTB to fluoride exposure, the purpose of this study was to investigate the effects of occupational fluoride exposure on the central nervous system and to determine to what extent the level of exposure correlates with those effects and hopefully thereby provide early warning indicators that can be used to protect the health of workers who have occupational contact with fluoride.

Results: The results of the NCTB testing in this investigation revealed significant differences among the fluoride-exposed groups for various indices as compared to reference standards and the controls, with particular deficits in attention, auditory retention, and physical dexterity and acuity as well as abnormal emotional states. These

findings are consistent with the symptoms of endemic fluoride poisoning, suggesting occupational exposure to fluoride has harmful effects on the higher functions of the central nervous system, negatively influencing both cognitive and autonomic functioning. There is a definite relationship between the damage caused by fluoride and the level of exposure."

Source: Guo Z, et al. (2001). Study on neurobehavioral function of workers occupationally exposed to fluoride. Industrial Health and Occupational Disease 27:346-348. (Republished in Fluoride 2008; 41:152-55).

"After controlling by significant confounders, urinary fluoride correlated positively with reaction time and inversely with the scores in visuospatial organization. IQ scores were not influenced by fluoride exposure. An increase in reaction time could affect the attention process, also the low scores in visuospatial organization could be affecting the reading and writing abilities in these children."

Source: Calderon J, et al. (2000). Influence of fluoride exposure on reaction time and visuospatial organization in children. Epidemiology 11(4): S153.

"This study assessed the health effects associated with occupational exposure to methyl bromide and sulfuryl fluoride among structural fumigation workers. . . . Sulfuryl fluoride exposure over the year preceding examination was associated with significantly reduced performance on the Pattern Memory Test and on olfactory testing. . . . Conclusions: Occupational sulfuryl fluoride exposures may be associated with subclinical effects on the central nervous system, including effects on olfactory and some cognitive functions."

Source: Calvert GM, et al. (1990). Health effects associated with sulfuryl fluoride and methyl bromide exposure among structural fumigation workers. Am J Public Health. 88(12):1774-80.

"Neurobehavioral functions affected by methyl bromide exposure were evaluated in California structural and soil fumigators using methyl bromide and sulfuryl fluoride. . . . The greater number of symptoms and reduced performance on all cognitive tests in sulfuryl fluoride fumigators compared to the Reference Group plus the absence of published research on this compound suggest that the data base for sulfuryl fluoride is inadequate."

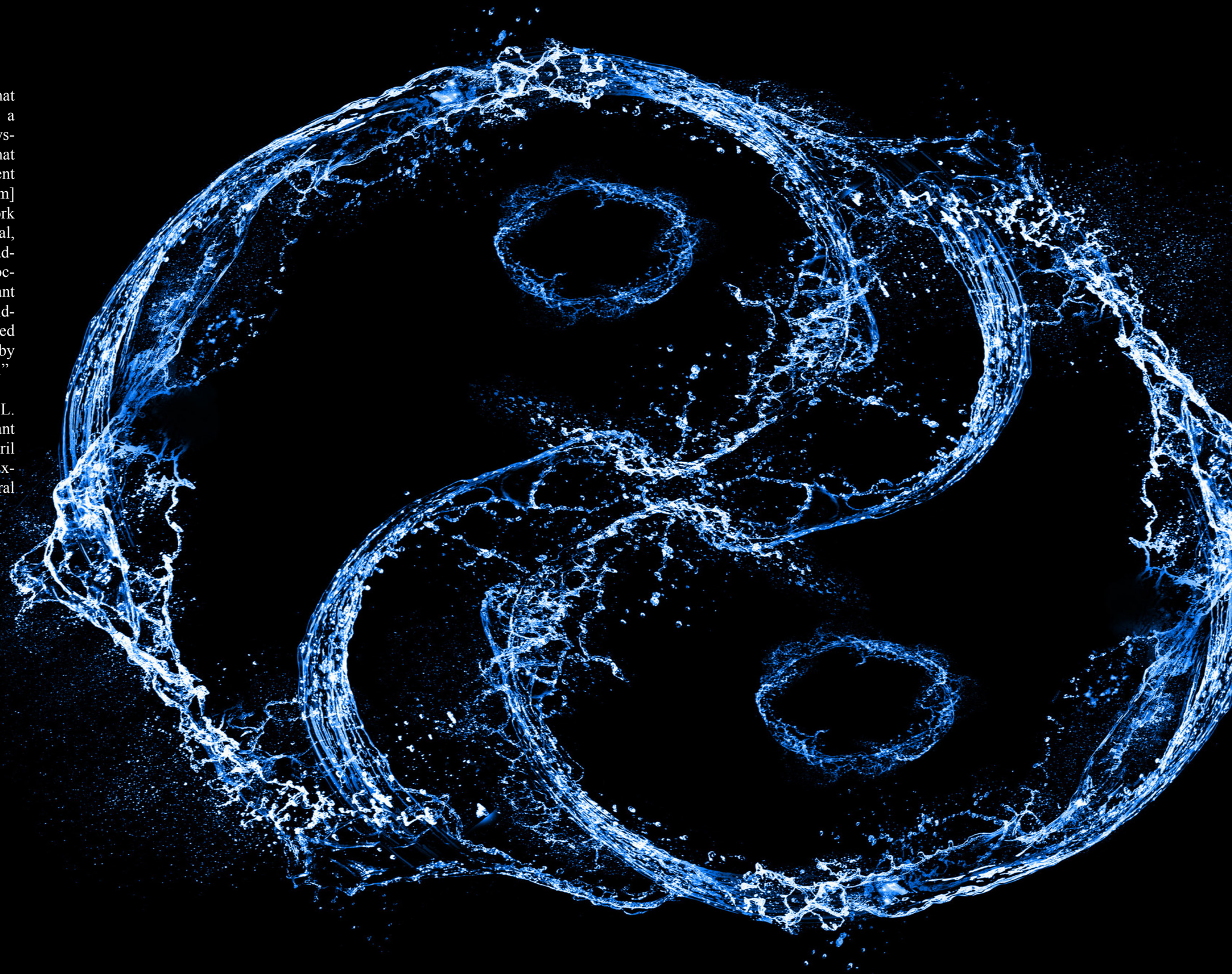
Source: Anger WK, et al. (1986). Neurobehavioral evaluation of soil and structural fumigators using methyl bromide and sulfuryl fluoride. Neurotoxicology. 7(3):137-56.

"Two experiments were conducted in order to determine if challenge testing, a procedure developed by clinical allergists, could be used to provoke behavioral reactions to chemicals found in municipal waters. In one experiment, 10 male and 32 female volunteers tracked a moving target and monitored lights after receiving sublingual drops that contained only water or varying amounts of sodium fluoride and nitrate. Dosage levels in this experiment equaled, exceeded, of fell below those found in municipal waters. In a second experiment, 20 females performed this task after receiving sublingual drops of the same test substances in a repeated measures design; dosage levels equaled or exceeded levels found in municipal waters by 100 or 500 times. Neither type nor amount of chemical affected primary task performance; however, after receiving sublingual drops in the first (between-subjects) experiment, subjects paid less attention to lights on their right. In the second experiment, subjects made more errors and had longer response latencies after they received moderate and very high concentrations of the test substances. It was concluded that challenge testing is a safe but effective technique for provoking and studying reactions to chemicals when it is combined with a sensitive measure of sensorimotor performance."

Source: Rotton J, et al. (1983). Behavioral Effects of Chemicals in Drinking Water. Journal of Applied Psychology 67:230-38.

“Clinical evidence suggests that uranium hexafluoride may have a rather marked central nervous system effect... It seems most likely that the F [code for fluoride] component rather than the T [code for uranium] is the causative factor... Since work with these compounds is essential, it will be necessary to know in advance what mental effects may occur after exposure. This is important not only to protect a given individual, but also to prevent a confused workman from injuring others by improperly performing his duties.”

Source: Letter to Col. Stafford L. Warren from John L. Ferry, Assistant Captain, U.S. Medical Corps. (April 19, 1944). Request for Animal Experimentation to Determine Central Nervous System Effects.



FLUORIDES NEUROBEHAVIORAL EFFECTS ON ANIMALS

“The results of the present study indicate that perinatal exposure to sodium fluoride (NaF), at dose levels below those associated with gross malformations and/or overt neurotoxic effects, produces both short and long term sex and dose specific neurobehavioural alterations in rat offspring.”

Source: Bera I, et al. (2007). Neurofunctional effects of developmental sodium fluoride exposure in rats. European Review for Medical and Pharmacological Sciences 11(4):211-24.

“Administration of sodium fluoride with drinking water produced both behavioural and dental toxicities and not lethality in the present study. A suppression of spontaneous motor activity, a shortening of rota-rod endurance time, a decreased body weight gain and food intake, a suppression of total cholinesterase and acetylcholinesterase activities and dental lesion were observed in test animals.”

Source: Ekambaram P, Paul V. (2001). Calcium preventing locomotor behavioral and dental toxicities of fluoride by decreasing serum fluoride level in rats. Environmental Toxicology and Pharmacology 9(4):141-146.

“Sodium fluoride treatment suppressed spontaneous motor activity. But no change was observed in the motor coordination of these animals. A suppression of spontaneous motor activity suggests that fluoride has, by a central action, inhibited motivation of these animals to exhibit locomotor behavior.”

Source: Paul V, et al. (1998). Effects of sodium fluoride on locomotor behavior and a few biochemical parameters in rats. Environmental Toxicology and Pharmacology 6: 187–191.

“This study demonstrates a link between certain fluoride exposures and behavioral disruption in the rat. The effect on behavior varied with the timing of exposure during CNS development. Behavioral changes common to weanling and adult exposures were different from those after prenatal exposures... Experience with other developmental neurotoxicants prompts expectations that changes in behavioral function will be comparable across species, especially humans and rats... [A] generic behavioral pattern disruption as found in this rat study can be indicative of a potential for motor dysfunction, IQ deficits and/or learning disabilities in humans.”

Source: Mullenix P, et al. (1995). Neurotoxicity of Sodium Fluoride in Rats. Neurotoxicology and Teratology 17:169-177.

“In this experiment, the freeze response to auditory stimuli in the pups showed significant delay, indicating that relatively high doses of fluoride can negatively influence the development of auditory nerves. Guan Zhizhong et al[8] report that the offspring of rats exposed to fluoride have retarded cerebral development and exhibit changes in neural cell ultrastructure. The results of the present experiment suggest that the effects of high doses of fluoride on the behavior development of the offspring are visible primarily as slight delays in response times, particularly with regard to motor and coordination function and well as muscle strength. The measurement of the thickness of the cerebral cortex of offspring on day 21 revealed that the 25 mg/L group had a significantly thinner cerebral cortex as compared to the control; this histological analysis indicates that fluoride slows the growth of brain cells.”

Source: Wu N, et al. (1995). Research on the abnormal behavior of rats exposed to fluoride. Chinese Journal of Control of Endemic Diseases 14(5):271.

“When rats were treated 6 hr a day for 5 mo. with HF concentrations of 3, 1, 0.5, and 0.1 mg/m-3, it caused functional changes in the CNS, as shown by the condition reflex method and the measurement of chronaxy. There was inhibition of the blood alkaline phosphatase activity and pathomorphological changes in the CNS, bone and tooth tissues and internal organs. The extent of the changes depended on the concentration of HF. The maximum allowable concentration of HF for the air at working places presently accepted, 0.5 mg/m-3, is too high.”

Source: Vishnevskii VL, El Nichnykh LN. (1969). (A toxicological and morphological characterization of the action of different concentrations of inhaled hydrogen fluoride on the body.). Tr Tsentr Nauchno-Issled Proektn-Konstr In. 2: 143-147.

“General malaise, asthenia, and apathy developed to a marked degree in the monkeys exposed to the BeF2 (beryllium fluoride) aerosol, and in those under the heaviest BeHPO4 exposure. The monkeys retreated to the furthest corner of their cages and paid no attention to light flashed at them. They remained in this withdrawn and listless condition until death. Monkeys which inhaled the BeSO4 aerosol faired best of all.”

Source: Schepers GWH. (1964). Biological action of beryllium: Reaction of the monkey to inhaled aerosols. Industrial Medicine and Surgery 33: 1-16.

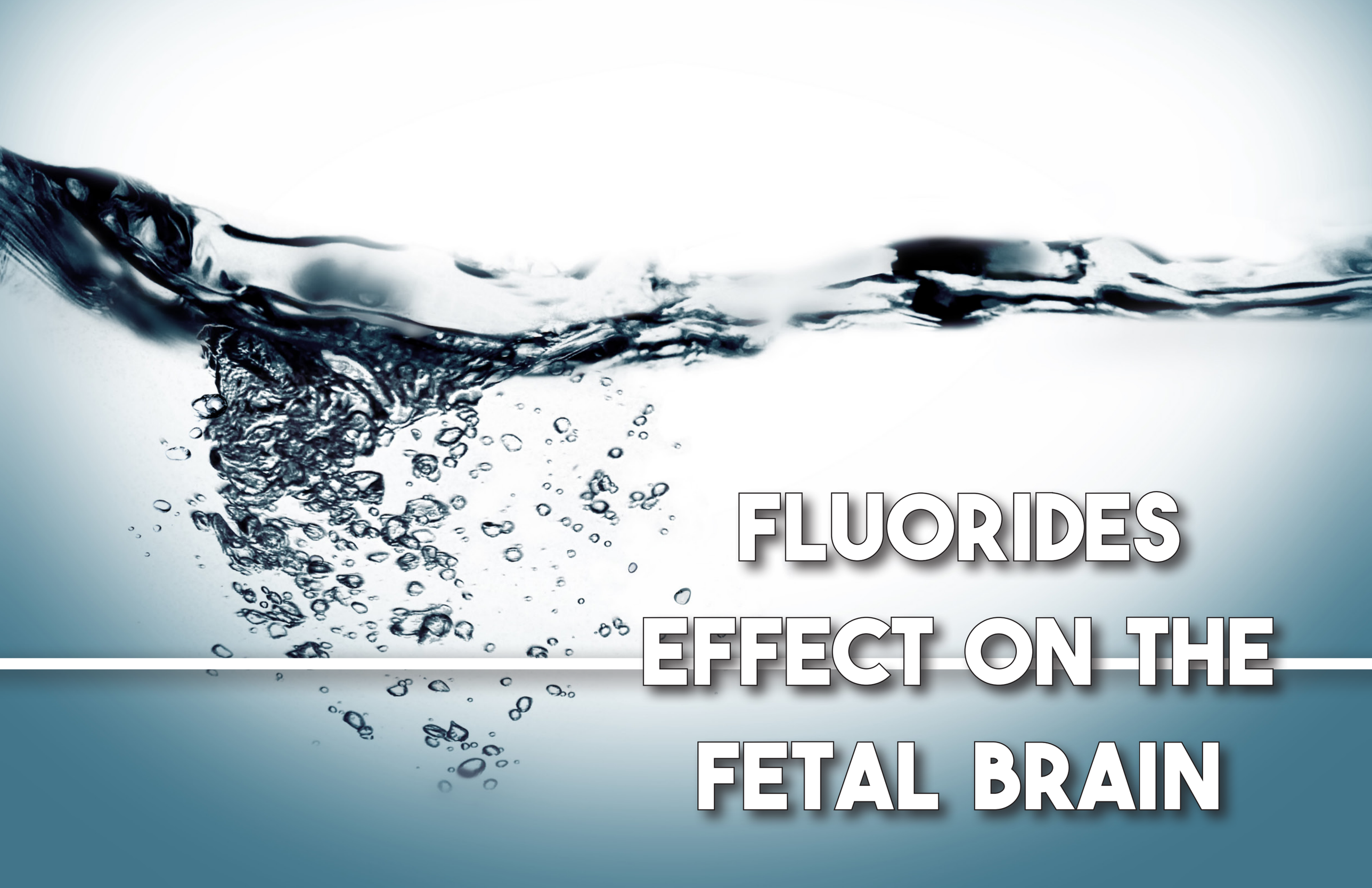
The human placenta does not prevent the passage of fluoride from a pregnant mother's bloodstream to the fetus. As a result, a fetus can be harmed by fluoride ingested pregnancy. Based on research from China, the fetal brain is one of the organs susceptible to fluoride poisoning.

As highlighted by the excerpts below, three Chinese studies have investigated fluoride's effect on the fetal brain and each has found evidence of significant neurological damage, including neuronal degeneration and reduced levels of neurotransmitters such as norepinephrine. As noted by Yu (1996), "when norepinephrine levels drop the ability to maintain an appropriate state of activation in the central nervous system is weakened." Studies of fluoride-treated animals have reported similar effects, including lower levels of norepinephrine. (Kaur 2009; Li 1994).

The Safe Level Is Not Yet Known

The fluoride levels which the pregnant women in these studies were exposed are higher than most women in western countries can expect to ingest. The safety of lower fluoride levels to fetal brain development has not yet been investigated, and remains to be determined. Interestingly, in the 1960s, the FDA banned the use of prenatal fluoride supplements based on its concern about possible untoward effects on the fetus.

It should also be noted that women who drink large quantities of tea will likely have similar blood fluoride levels as the women in these studies. Further, if a pregnant woman receives a fluoride gel treatment from the dentist, her blood fluoride levels can go extremely high for up to 15 hours, exceeding the reported short-term exposure levels that impair glucose metabolism and kidney function in human adults and sperm quality in rams. The potential ramifications of these fluoride spikes on the health of the fetus has not been considered in the literature to date.



FLUORIDES EFFECT ON THE FETAL BRAIN

The Yu/Dong Studies

The following two papers provide results from a single investigation of 20 fetuses (10 from a high-fluoride area, and 10 from a low-fluoride area). A third paper from this investigation examined fluoride's effect on cellular ultrastructure in other tissues and is included at the bottom of this page:

"The mothers of the ten fetuses that formed the subject group for this study all had dental fluorosis, with a corresponding increase in urinary fluoride, indicating that these pregnant women were suffering from chronic fluoride poisoning. The excess fluoride of the mother was passed through the placental barrier into the fetus, and from there through the blood-brain barrier to accumulate in the fetal brain, leading to a significant rise in bone and brain fluoride levels. Our results are consistent with earlier reports. Previous experiments have shown that the brains of fetuses from endemic fluorosis areas as well as fluoride-poisoned rats manifest morphological changes. Following experimental testing of the monoamine neurotransmitters in fetuses from fluorosis endemic areas, the present study found lowered levels of norepinephrine and elevated levels of epinephrine. The presence of norepinephrine in the brain allows the organism to become alert, and guards against the intensification of reflex reactions and other behavior. Norepinephrine also plays a role in the regulation of complex response mechanisms, emotions, cerebrocardiovascular function, etc. When norepinephrine levels drop the ability to maintain an appropriate state of activation in the central nervous system is weakened. The elevated levels of epinephrine could be due to a blockage of the pathway that transforms epinephrine into norepinephrine or possibly due to suppression of the relevant metabolic enzymes, causing the brain levels of epinephrine to increase, and the levels of norepinephrine to decrease."

Source: Yu Y, et al. (1996). Neurotransmitter and receptor changes in the brains of fetuses from areas of endemic fluorosis. Chinese Journal of Endemiology 15:257-259.
Link: http://www.fluoridealert.org/wp-content/uploads/yu-1996.pdf

"The contents of five types of amino-acid neurotransmitters and three types of monoamine neurotransmitters in the brains of fetuses aborted through induced labor in a chronic fluorosis-endemic area were determined. Findings revealed that the content of the excitatory amino acid, aspartic acid, was significantly lower than in the fetuses from the non-endemic area whereas the content of the inhibitory amino acid, taurine, was significantly higher; the content of the major spinal cord-inhibitory glycine was significantly reduced. Among the monoamine neurotransmitters, the content of norepinephrine was significantly reduced; the contents of 5-hydroxytryptamine in the frontal and the occipital lobes were elevated and the content of 5-hydroxytryptamine in the parietal lobe (precentral and postcentral gyri) was reduced."

Source: Dong Z, et al. (1993). Determination of the contents of amino-acid and monoamine neurotransmitters in fetal brains from a fluorosis-endemic area. Journal of Guiyang Medical College 18(4):241-45.
Link: http://www.fluoridealert.org/wp-content/uploads/dong-1993.pdf

The Du Study

"It is known that fluoride can cross the placenta from the mother's blood to the developing fetus. However, the theory there is a direct link between fluoride effects and brain cell damage is still controversial due to lack of adequate evidence. In order to determine if there are any adverse effects on the developing human brain, especially starting from formation of the embryo, fetuses from an endemic fluorosis area at the 5th–8th month of gestation were compared with those from a non-endemic area. RESULTS: Normal Purkinje cells from the non-endemic fluorosis area were observed in single or parallel lines and were well organized in the fetal cerebellum. Purkinje cells of fetuses from the endemic fluorosis area were abnormally disorganized and had a thicker granulated layer in the cerebellum. Other dysmorphology, including higher nucleus-cytoplasm ratio of brain cones, hippocampus cones,

and Purkinje cone cells, supports the theory that fluoride has an adverse effect on brain development. SEM analysis also found reduced neurons of brain cortex, decreased numerical density, volume density, and surface density in those fetuses from the endemic fluorosis area. In summary, the passage of fluorine through the placenta of mothers with chronic fluorosis and its accumulation within the brain of the fetus impacts the developing central nervous system and stunts neuron development."

Source: Du L. (1992). The effect of fluorine on the developing human brain. Chinese Journal of Pathology 21(4):218-20. Link: http://www.fluoridealert.org/wp-content/uploads/du-1992.pdf

The Han Study

"In recent years, researchers have noted that fluoride poisoning appears to begin in the fetal stage. Our study collected specimens from induced abortions in both fluoride endemic areas and non-affected areas and, by means of histochemical analysis, enzyme-chemical analysis, light microscopy, and electron microcopy, investigated the effects of fluoride on the fetus, providing evidence for early childhood contraction of fluorosis. RESULTS: When the various hard and soft tissues taken from fetuses as part of this study were tested for fluoride, the results showed that the brain and bone tissue of the fluoride endemic area fetuses had higher fluoride content than the controls ($P < 0.05$). The reason for this disparity is the previous excess fluoride intake of the mother. Fluoride can pass through the blood-brain barrier and accumulate in brain tissue. Thus in our study the brain tissue of the fetuses from the fluoride endemic area showed higher fluoride levels than the control. The mechanisms involved are not yet clear. Besides increased amounts of fluoride, the brain tissue of the endemic subjects also showed nerve cells with swollen mitochondria, expanded granular endoplasmic reticula, grouping of the chromatin, damage to the nuclear envelope, a lower number of synapses, fewer mitochondria, microtubules, and vesicles within the synapses, and damage to the synaptic membrane. These changes indicate that fluoride can retard the growth and division of cells in the cerebral cortex. Fewer mitochondria, microtubules, and vesicles within the synapses could lead to fewer connections between neurons and abnormal synaptic function, influencing the intellectual development after birth. These questions await further research."

Source: Han H, et al. (1989). Effects of fluorine on the human fetus. Chinese Journal of Control of Endemic Diseases 4:136-138. Link:
http://www.fluoridealert.org/wp-content/uploads/han-1989.pdf

The following study involves the same fetal tissue that was examined in the Yu (1996) and Dong (1993) studies. Rather than investigating fluoride's effect on the brain, however, this study examined fluoride's effect on the ultrastructure of cells in several tissues in the body, including from the thyroid gland. As can be seen in the following description, the fetuses from the fluoride-exposed women were experiencing a systemic toxic effect.

Objective: Ultrastructural changes of epithelial cells of livers, adrenal glands, and thyroid glands of human fetuses from a fluorosis-endemic area were observed to provide the experimental basis for research into the mechanism of cellular damage caused by fluoride. Methods: 10 human fetuses in a fluorosis-endemic area were collected, whose mothers all had dental fluorosis with urinary fluoride content of (4.37 ± 2.94) mg/L. 10 human fetuses in a non-fluorosis-endemic area were collected, whose mothers had no dental fluorosis with urinary fluoride content of (1.67 ± 0.82) mg/L. The fluoride electrode method was used to test the fluoride content in fetal bones. Tissues of livers, adrenal glands, and thyroid glands of the fetuses were taken for electron microscopic examinations.

Results: Electron microscopic examinations showed: the major changes of cell membranes were microvilli that were shortened, reduced in number or even vanished. Intercellular connections were loose and their structure was disordered. Myelin-like structures were formed in those with severe pathological changes. The major mitochondrial changes were: swollen mitochondria with increased volume, and even vanished and vacuolated cristae. The major pathological changes of endoplasmic reticulum were dilated and vesicular rough endoplasmic reticulum, and partially depleted nucleoproteins on the rough endoplasmic reticulum. The major pathological changes of cell nuclei were damaged and dilated, vesicular dual-layer structures of nuclear membranes. Huge inclusion bodies or particles with relatively high abnormal electron density appeared in some cytoplasm. Conclusions: Fluoride damage to cell structures was multifaceted. Cell membranes, mitochondria, rough endoplasmic reticulum, and nuclear membranes could all be damaged at the time of fluorosis.

Source: Yu Y. (2000). Effects of fluoride on the ultrastructure of glandular epithelial cells of human fetuses. Chinese Journal of Endemiology 19(2):81-83.

Link: http://www.fluoridealert.org/wp-content/uploads/yu-2000.pdf

FLUORIDE INTAKE FROM TOOTHPASTE VS RECOMMENED DAILY INTAKE FROM ALL SOURCES

For many children, fluoride toothpaste is the largest source of fluoride intake. One strip of fluoridated toothpaste on a child-sized toothbrush contains between 0.75 and 1.5 mg of fluoride, which is more fluoride than is found in many prescription fluoride supplements (0.25 to 1.0 mg per tablet). Since young children are known to swallow a large amount of the toothpaste they place in their mouth, use of fluoride toothpaste–particularly when done without the supervision of a parent–can result in dangerous levels of fluoride exposure. Ingestion of excessive fluoride toothpaste is a major risk factor for dental fluorosis, and can cause symptoms of acute fluoride toxicity (e.g., stomach pain, nausea, etc).

Many Children Exceed The Recommended Fluoride Intake From Toothpaste Alone

Studies have found that children can easily ingest more fluoride from toothpaste alone than is recommended as a total fluoride intake from all sources. As noted in the Journal of Public Health Dentistry:

"Virtually all authors have noted that some children could ingest more fluoride from [toothpaste] alone than is recommended as a total daily fluoride ingestion." (Levy 1999).

A quick look at the data readily confirms the accuracy of this statement. As noted by Dr. Stephen Levy, two-to-three year old children ingest an average of 0.3 grams of toothpaste per brushing, which equates to 0.3 to 0.45 mg of fluoride. (Levy 1993). At two brushings per day, the average two-to-three year old would ingest between 0.6 and 0.9 mg of fluoride from toothpaste each day. Some children who brush twice a day will swallow far more than this. Research has found, for example, that 10% of children swallow more than double the "average" amount. Among these children, fluoride ingestion from toothpaste will range up to 2 mg per day.

To put these doses in perspective, the Institute of Medicine recommends that two-to-three year old children ingest 0.7 mg of fluoride per day from ALL sources, and that the "upper tolerable intake" is 1.3 mg/day. Many children will thus ingest more fluoride from toothpaste alone than is recommended as a total daily ingestion, and some will even ingest more than is deemed "tolerable."

The figures at right contrast the average fluoride intake from toothpaste among children who brush twice a day with the recommended daily intake from all sources.

Fluoride Intake from Toothpaste vs. Recommended Daily Intake from ALL Sources

Age	Avgerage Intake 2 brushings (1,100 ppm F)	Percent of Recommended Total Intake	Reference
2 Years	0.73mg	104%	Naccahe 1987**
2.5 Years	0.59mg	84%	Bentley 1999
2-3 Years	0.62mg	89%	Simard 1984**
2-4 Years	0.60mg	96%	Barnhart 1976**
3 Years	0.40mg	57%	Naccahe 1985**
3-6 Years	0.84mg	76%	Hargreaves 1975**
4 Years	0.86mg	78%	Simard 1984**
4 Years	0.29mg	26%	Ericsson 1974**
5 Years	0.44mg	48%	Simard 1984**

* Recommended Daily Intakes are taken from Table 2 of the Institute of Medicine's 1997 report: "Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride."

** Data derived from: Levy SM, Guha-Chowdhury N. (1999). Total fluoride intake and implications for dietary fluoride supplementation, Journal of Public Health Dentistry 59: 211-23.

THE NATIONAL RESEARCH COUNCILS REPORT ON FLUORIDE INTAKE

An overview of the NRC's groundbreaking report on fluoride toxicity, including excerpts of its key findings and recommendations, statements from the panelists, and a discussion of its relevance to water fluoridation and sulfuryl fluoride follows below.

The National Research Council's report concluded that EPA's safe drinking water standard (4 ppm) for fluoride is unsafe and "should be lowered." The NRC based this conclusion on its finding that EPA's 4 ppm standard places a person at increased risk for both tooth damage (severe dental fluorosis) and bone damage (bone fracture). While most of the press coverage of the NRC report focused on NRC's concerns with teeth and bone, there are many other serious concerns expressed in the NRC report. As evident in the following excerpts, the NRC report lends credence to fluoride's ability to affect a wide range of systems in the body, particularly the brain and endocrine system. These concerns are further amplified in the NRC's research recommendations.

Fluoride's Effects On The Brain

"On the basis of information largely derived from histological, chemical, and molecular studies, it is apparent that fluorides have the ability to interfere with the functions of the brain and the body by direct and indirect means." p.222

"A few epidemiologic studies of Chinese populations have reported IQ deficits in children exposed to fluoride at 2.5 to 4 mg/L in drinking water. Although the studies lacked sufficient detail for the committee to fully assess their quality and relevance to U.S. populations, the consistency of the results appears significant enough to warrant additional research on the effects of fluoride on intelligence." p.8

"histopathological changes similar to those traditionally associated with Alzheimer's disease in people have been seen in rats chronically exposed to AlF." p.212

"Fluorides also increase the production of free radicals in the brain through several different biological pathways. These changes have a bearing on the possibility that fluorides act to increase the risk of developing Alzheimer's disease." p.222

"More research is needed to clarify fluoride's biochemical effects on the brain." p.222

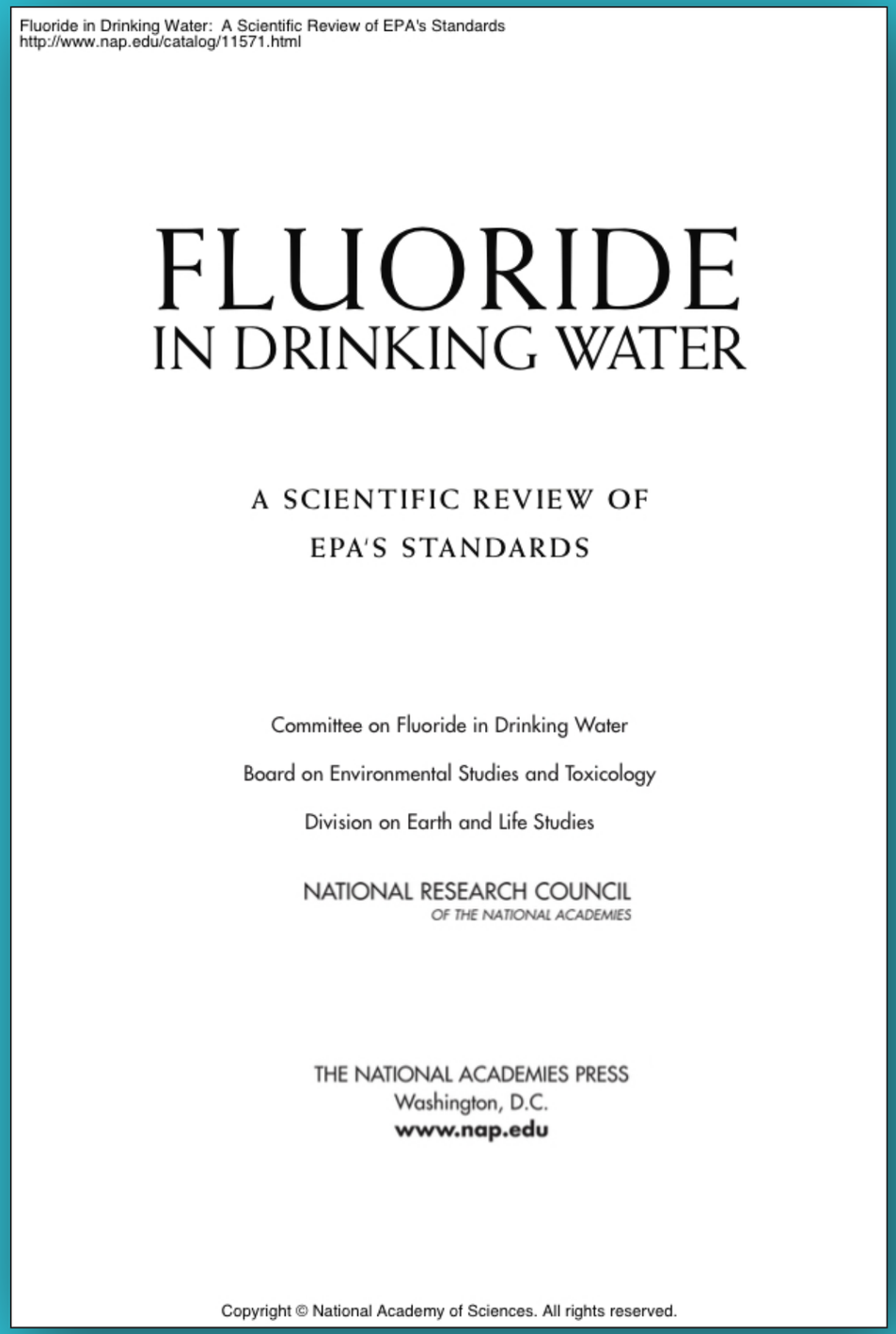
"The possibility has been raised by the studies conducted in China that fluoride can lower intellectual abilities. Thus, studies of populations exposed to different concentrations of fluoride in drinking water should include measurements of reasoning ability, problem solving, IQ, and short- and long-term memory." p.223

"Studies of populations exposed to different concentrations of fluoride should be undertaken to evaluate neurochemical changes that may be associated with dementia. Consideration should be given to assessing effects from chronic exposure, effects that might be delayed or occur late-in-life, and individual susceptibility." p.223

"Additional animal studies designed to evaluate reasoning are needed." p.223

Fluoride's Effects On The Endocrine System

"In summary, evidence of several types indicates that fluoride affects normal endocrine function or response; the effects of the fluoride-induced changes vary in degree and kind in different individuals. Fluoride is therefore an endocrine disruptor in the broad sense of altering normal endocrine function or response, although probably not in the sense of mimicking a normal hormone. The mechanisms of action remain to be worked out and appear to include both direct and indirect mechanisms, for example, direct stimulation or inhibition of hormone secretion



Fluoride in Drinking Water: A Scientific Review of EPA's Standards
http://www.nap.edu/catalog/11571.html

FLUORIDE
IN DRINKING WATER

A SCIENTIFIC REVIEW OF
EPA'S STANDARDS

Committee on Fluoride in Drinking Water

Board on Environmental Studies and Toxicology

Division on Earth and Life Studies

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

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by interference with second messenger function, indirect stimulation or inhibition of hormone secretion by effects on things such as calcium balance, and inhibition of peripheral enzymes that are necessary for activation of the normal hormone." p.266

"Some of these [endocrine] effects are associated with fluoride intake that is achievable at fluoride concentrations in drinking water of 4 mg/L or less, especially for young children or for individuals with high water intake. Many of the effects could be considered subclinical effects, meaning that they are not adverse health effects. However, recent work on borderline hormonal imbalances and endocrine-disrupting chemicals indicated that adverse health effects, or increased risks for developing adverse effects, might be associated with seemingly mild imbalances or perturbations in hormone concentrations. Further research is needed to explore these possibilities." p.8

"Further effort is necessary to characterize the direct and indirect mechanisms of fluoride's action on the endocrine system and the factors that determine the response, if any, in a given individual." p.266

"The effects of fluoride on various aspects of endocrine function should be examined further, particularly with respect to a possible role in the development of several diseases or mental states in the United States." p.267

Fluoride's Effect On The Thyroid

"several lines of information indicate an effect of fluoride exposure on thyroid function." p.234

"it is difficult to predict exactly what effects on thyroid function are likely at what concentration of fluoride exposure and under what circumstances." p.234-5

"Fluoride exposure in humans is associated with elevated TSH concentrations, increased goiter prevalence, and altered T4 and T3 concentrations; similar effects on T4 and T3 are reported in experimental animals.." p.262

"In humans, effects on thyroid function were associated with fluoride exposures of 0.05-0.13 mg/kg/day when iodine intake was adequate and 0.01-0.03 mg/kg/day when iodine intake was inadequate." p.262-3

"The recent decline in iodine intake in the United States (CDC 2002d; Larsen et al. 2002) could contribute to increased toxicity of fluoride for some individuals." p.263

"Intake of nutrients such as calcium and iodine often is not reported in studies of fluoride effects. The effects of fluoride on thyroid function, for instance, might depend on whether iodine intake is low, adequate, or high, or whether dietary selenium is adequate." p.265

Fluoride's Effect On The Pineal Gland

"The single animal study of pineal function indicates that fluoride exposure results in altered melatonin production and altered timing of sexual maturity (Table 8-1). Whether fluoride affects pineal function in humans remains to be demonstrated. The two studies of menarcheal age in humans show the possibility of earlier menarche in some individuals exposed to fluoride, but no definitive statement can be made. Recent information on the role of the pineal organ in humans suggests that any agent that affects pineal function could affect human health in a variety of ways, including effects on sexual maturation, calcium metabolism, parathyroid function, postmenopausal osteoporosis, cancer, and psychiatric disease." p.264

Fluoride's Effects On Insulin Secretion and Diabetes

"The conclusion from the available studies is that sufficient fluoride exposure appears to bring about increases in blood glucose or impaired glucose tolerance in some individuals and to increase the severity of some types of diabetes. In general, impaired glucose metabolism appears to be associated with serum or plasma fluoride concentrations of about 0.1 mg/L or greater in both animals and humans. In addition, diabetic individuals will often have higher than normal water intake, and consequently, will have higher than normal fluoride intake for a given concentration of fluoride in drinking water. An estimated 16-20 million people in the U.S. have diabetes mellitus; therefore, any role of fluoride exposure in the development of impaired glucose metabolism or diabetes is potentially significant." p.260

Fluoride's Effects On The Immune System

"Nevertheless, patients who live in either an artificially fluoridated community or a community where the drinking water naturally contains fluoride at 4 mg/L have all accumulated fluoride in their skeletal systems and potentially have very high fluoride concentrations in their bones. The bone marrow is where immune cells develop and that could affect humoral immunity and the production of antibodies to foreign chemicals." p.293-4

"There is no question that fluoride can affect the cells involved in providing immune responses. The question is what proportion, if any, of the population consuming drinking water containing fluoride at 4.0 mg/L on a regular basis will have their immune systems compromised? Not a single epidemiologic study has investigated whether fluoride in the drinking water at 4 mg/L is associated with changes in immune function. Nor has any study examined whether a person with an immunodeficiency disease can tolerate fluoride ingestion from drinking water." p.295

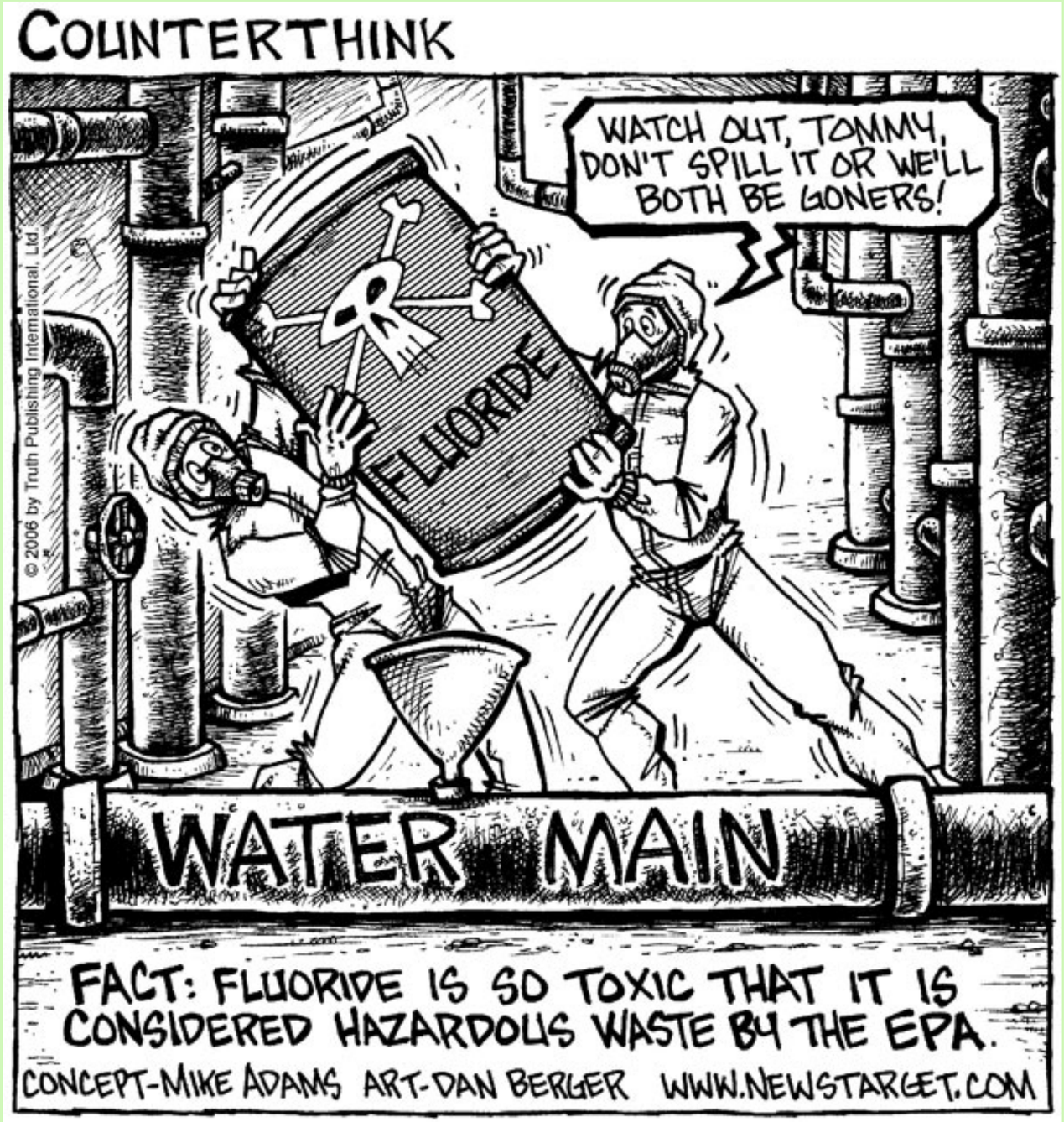
"bone concentrates fluoride and the blood-borne progenitors could be exposed to exceptionally high fluoride concentrations. Thus, more research needs to be carried out before one can state that drinking water containing fluoride at 4 mg/L has no effect on the immune system." p.295

"it is important to consider subpopulations that accumulate large concentrations of fluoride in their bones (e.g., renal patients). When bone turnover occurs, the potential exists for immune system cells and stem cells to be exposed to concentrations of fluoride in the interstitial fluids of bone that are higher than would be found in serum. From an immunologic standpoint, individuals who are immunocompromised (e.g., AIDS, transplant, and bone-marrow-replacement patients) could be at greater risk of the immunologic effects of fluoride." p.302

"Within 250 µm of a site of resorption, it is possible to encounter progenitor cells that give rise to bone, blood, and fat. Thus, one must assume that these cells would be exposed to high concentrations of fluoride. At this time, it is not possible to predict what effect this exposure would have on the functioning of skeletal elements, hematopoiesis, and adipose formation." p.142

"It is paramount that careful biochemical studies be conducted to determine what fluoride concentrations occur in the bone and surrounding interstitial fluids from exposure to fluoride in drinking water at up to 4 mg/L, because bone marrow is the source of the progenitors that produce the immune system cells." p.303

"In addition, studies could be conducted to determine what percentage of immunocompromised subjects have adverse reactions when exposed to fluoride in the range of 1-4 mg/L in drinking water." p.303



Fluoride's Interactive And Synergistic Effects With Iodine, Aluminum And Other Elements

"Intake of nutrients such as calcium and iodine often is not reported in studies of fluoride effects. The effects of fluoride on thyroid function, for instance, might depend on whether iodine intake is low, adequate, or high, or whether dietary selenium is adequate." p.265

"Better characterization of exposure to fluoride is needed in epidemiology studies investigating potential effects. Important exposure aspects of such studies would include the following: collecting data on general dietary status and dietary factors that could influence exposure or effects, such as calcium, iodine, and aluminum intakes." p.88
"Available information now indicates a role for aluminum in the interaction of fluoride on the second messenger system; thus, differences in aluminum exposure might explain some of the differences in response to fluoride exposures among individuals and populations." p.265

"With the increasing prevalence of acid rain, metal ions such as aluminum become more soluble and enter our day-to-day environment; the opportunity for bioactive forms of AlF to exist has increased in the past 100 years. Human exposure to aluminofluorides can occur when a person ingests both a fluoride source (e.g., fluoride in drinking water) and an aluminum source; sources of human exposure to aluminum include drinking water, tea, food residues, infant formula, aluminum-containing antacids or medications, deodorants, cosmetics, and glassware." p.51

"Further research should include characterization of both the exposure conditions and the physiological conditions (for fluoride and for aluminum or beryllium) under which aluminofluoride and beryllofluoride complexes can be expected to occur in humans as well as the biological effects that could result." p.52

"Another possible explanation for increased blood lead concentrations which has not been examined is the effect of fluoride intake on calcium metabolism; a review by Goyer (1995) indicates that higher blood and tissue concentrations of lead occur when the diet is low in calcium. Increased fluoride exposure appears to increase the dietary requirement for calcium (see Chapter 8); in addition, the substitution of tap-water based beverages (e.g., soft drinks or reconstituted juices) for dairy products would result in both increased fluoride intake and decreased calcium intake." p.52

"[G]iven the expected presence of fluoride ion (from any fluoridation source) and silica (native to the water) in any fluoridated tap water, it would be useful to examine what happens when that tap water is used to make acidic beverages or products (commercially or in homes), especially fruit juice from concentrate, tea, and soft drinks. Although neither Urbansky (2002) nor Morris (2004) discusses such beverages, both indicate that at pH < 5, SiF6 2- would be present, so it seems reasonable to expect that some SiF6 2- would be present in acidic beverages but not in the tap water used to prepare the beverages. Consumption rates of these beverages are high for many people, and therefore the possibility of biological effects of SiF62-, as opposed to free fluoride ion, should be examined." p.53

THERE IS POISON IN THE TAP WATER.

FACT: Fluoride is a dangerous substance and the active ingredient in most insecticides! If ingested, as little as 1/10 an ounce of fluoride can kill a 100 lbs adult and 1/100 of an ounce can kill a 10 pound infant. Studies have shown that exposure to fluoride can cause neurological damage, and an increased risk of bone cancer.

FICTION: Fluoride added to the public water supply strengthens teeth and helps prevent cavities.

Fluoride's Effects On The Reproductive System

"A few human studies suggested that high concentrations of fluoride exposure might be associated with alterations in reproductive hormones, effects on fertility, and developmental outcomes, but design limitations make those studies insufficient for risk evaluation." p.8

"the relationship between fertility and fluoride requires additional study." p.193

Fluoride And Down's Syndrome

"The possible association of cytogenetic effects with fluoride exposure suggests that Down's syndrome is a biologically plausible outcome of exposure." p.197

"A reanalysis of data on Down's syndrome and fluoride by Takahashi (1998) suggested a possible association in children born to young mothers. A case-control study of the incidence of Down's syndrome in young women and fluoride exposure would be useful for addressing that issue. However, it may be particularly difficult to study the incidence of Down's syndrome today given increased fetal genetic testing and concerns with confidentiality." p.204

Fluoride's Effects On The Gastrointestinal System

"The numerous fluoridation studies in the past failed to rigorously test for changes in GI symptoms and there are no studies on drinking water containing fluoride at 4 mg/L in which GI symptoms were carefully documented." p.269

"GI effects appear to have been rarely evaluated in the fluoride supplement studies that followed the early ones in the 1950s and 1960s." p.274

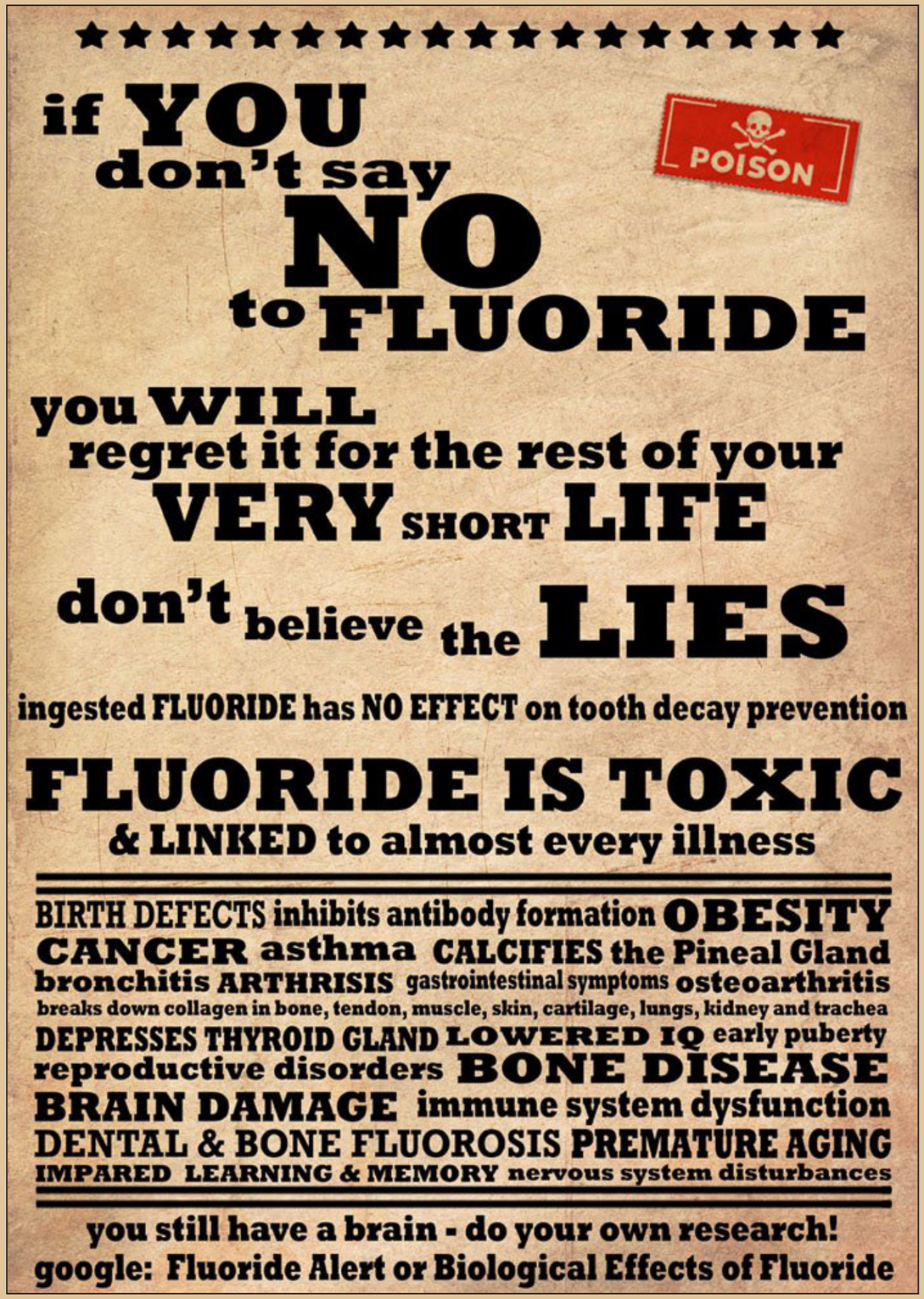
"The table suggests that fluoride at 4 mg/L in the drinking water results in approximately 1% of the population experiencing GI symptoms." p.274

"Whether fluoride activates G proteins in the gut epithelium at very low doses (e.g., from fluoridated water at 4.0 mg/L) and has significant effects on the gut cell chemistry must be examined in biochemical studies." p.280

"There are a few case reports of GI upset in subjects exposed to drinking water fluoridated at 1 mg/L. Those effects were observed in only a small number of cases, which suggest hypersensitivity. However, the available data are not robust enough to determine whether that is the case." p.295

"Studies are needed to evaluate gastric responses to fluoride from natural sources at concentrations up to 4 mg/L and from artificial sources." p.302

The National Research Council's 2007 Report runs 571 pages and is available for free from my personal Box account at this link: https://app.box.com/s/hicxgckx48a5e0glqwscyj9o5jnk3wpy



Fluoride's Effects On The Liver

"It is possible that a lifetime ingestion of 5-10 mg/day from drinking water containing 4 mg/L might turn out to have long-term effects on the liver, and this should be investigated in future epidemiologic studies." p.293

"The effect of low doses of fluoride on kidney and liver enzyme functions in humans needs to be carefully documented in communities exposed to different concentrations of fluoride in drinking water." p.303

Fluoride's Effects On The Kidney

"Human kidneys… concentrate fluoride as much as 50-fold from plasma to urine. Portions of the renal system may therefore be at higher risk of fluoride toxicity than most soft tissues." p.280

"Early water fluoridation studies did not carefully assess changes in renal function." p.280

"future studies should be directed toward determining whether kidney stone formation is the most sensitive end point on which to base the MCLG." p.281

"On the basis of studies carried out on people living in regions where there is endemic fluorosis, ingestion of fluoride at 12 mg per day would increase the risk for some people to develop adverse renal effects." p.281

"The effect of low doses of fluoride on kidney and liver enzyme functions in humans needs to be carefully documented in communities exposed to different concentrations of fluoride in drinking water." p.303

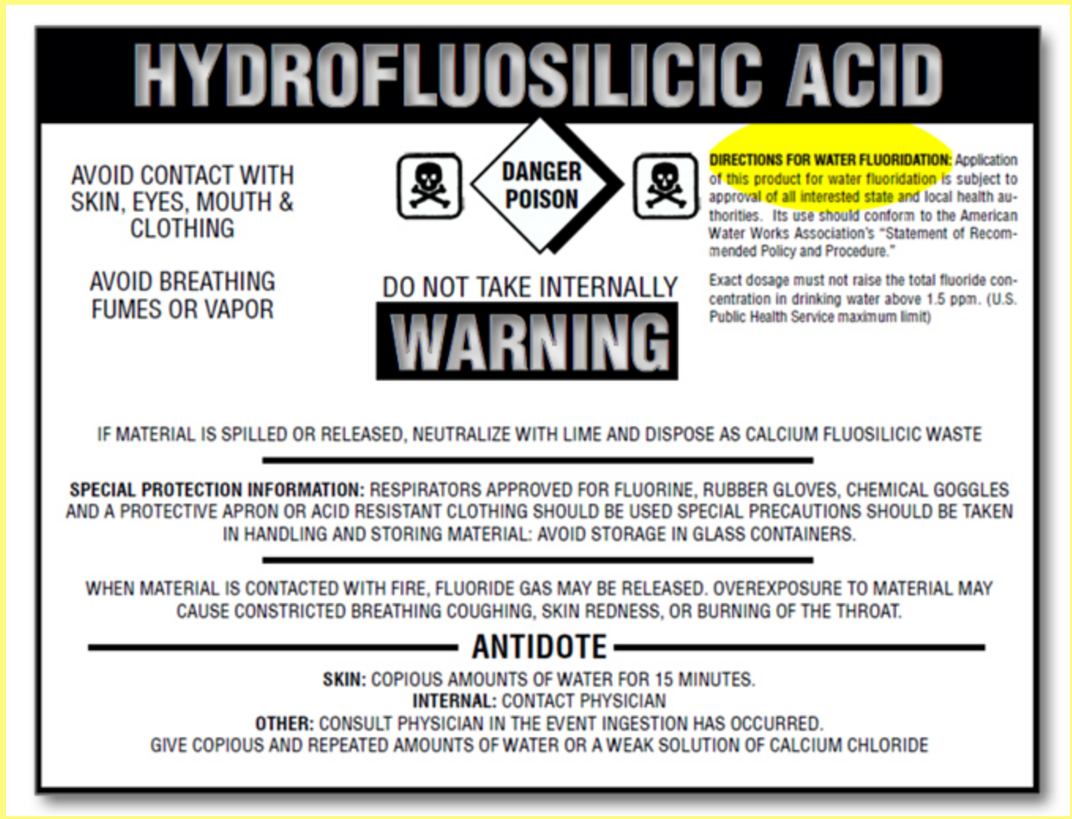
Fluoride And Cancer

"Fluoride appears to have the potential to initiate or promote cancers, particularly of the bone, but the evidence to date is tentative and mixed (Tables 10-4 and 10-5). As noted above, osteosarcoma is of particular concern as a potential effect of fluoride because of (1) fluoride deposition in bone, (2) the mitogenic effect of fluoride on bone cells, (3) animal results described above, and (4) pre-1993 publication of some positive, as well as negative, epidemiologic reports on associations of fluoride exposure with osteosarcoma risk." p.336

"Because fluoride stimulates osteoblast proliferation, there is a theoretical risk that it might induce a malignant change in the expanding cell population. This has raised concerns that fluoride exposure might be an independent risk factor for new osteosarcomas." p.134

"Osteosarcoma presents the greatest a priori plausibility as a potential cancer target site because of fluoride's deposition in bone, the NTP animal study findings of borderline increased osteosarcomas in male rats, and the known mitogenic effect of fluoride on bone cells in culture (see Chapter 5). Principles of cell biology indicate that stimuli for rapid cell division increase the risks for some of the dividing cells to become malignant, either by inducing random transforming events or by unmasking malignant cells that previously were in nondividing states." p.322

"Further research on a possible effect of fluoride on bladder cancer risk should be conducted." p.338



HYDROFLUOSILICIC ACID

AVOID CONTACT WITH SKIN, EYES, MOUTH & CLOTHING

AVOID BREATHING FUMES OR VAPOR

DANGER POISON

DO NOT TAKE INTERNALLY

WARNING

DIRECTIONS FOR WATER FLUORIDATION: Application of this product for water fluoridation is subject to approval of all interested state and local health authorities. Its use should conform to the American Water Works Association's "Statement of Recommended Policy and Procedure."

Exact dosage must not raise the total fluoride concentration in drinking water above 1.5 ppm. (U.S. Public Health Service maximum limit)

IF MATERIAL IS SPILLED OR RELEASED, NEUTRALIZE WITH LIME AND DISPOSE AS CALCIUM FLUOSILICIC WASTE

SPECIAL PROTECTION INFORMATION: RESPIRATORS APPROVED FOR FLUORINE, RUBBER GLOVES, CHEMICAL GOGGLES AND A PROTECTIVE APRON OR ACID RESISTANT CLOTHING SHOULD BE USED SPECIAL PRECAUTIONS SHOULD BE TAKEN IN HANDLING AND STORING MATERIAL: AVOID STORAGE IN GLASS CONTAINERS.

WHEN MATERIAL IS CONTACTED WITH FIRE, FLUORIDE GAS MAY BE RELEASED. OVEREXPOSURE TO MATERIAL MAY CAUSE CONSTRICTED BREATHING COUGHING, SKIN REDNESS, OR BURNING OF THE THROAT.

ANTIDOTE

SKIN: COPIOUS AMOUNTS OF WATER FOR 15 MINUTES.
INTERNAL: CONTACT PHYSICIAN
OTHER: CONSULT PHYSICIAN IN THE EVENT INGESTION HAS OCCURRED.
GIVE COPIOUS AND REPEATED AMOUNTS OF WATER OR A WEAK SOLUTION OF CALCIUM CHLORIDE

FLUORIDE IMPACT ON NEUROLOGICAL DEVELOPMENT IN CHILDREN

HARVARD SCHOOL OF PUBLIC HEALTH

Harvard School Of Public Health

For years health experts have been unable to agree on whether fluoride in the drinking water may be toxic to the developing human brain. Extremely high levels of fluoride are known to cause neurotoxicity in adults, and negative impacts on memory and learning have been reported in rodent studies, but little is known about the substance's impact on children's neurodevelopment.

In a meta-analysis, researchers from Harvard School of Public Health (HSPH) and China Medical University in Shenyang for the first time combined 27 studies and found strong indications that fluoride may adversely affect cognitive development in children. Based on the findings, the authors say that this risk should not be ignored, and that more research on fluoride's impact on the developing brain is warranted. The study was published online in Environmental Health Perspectives on July 20, 2012.

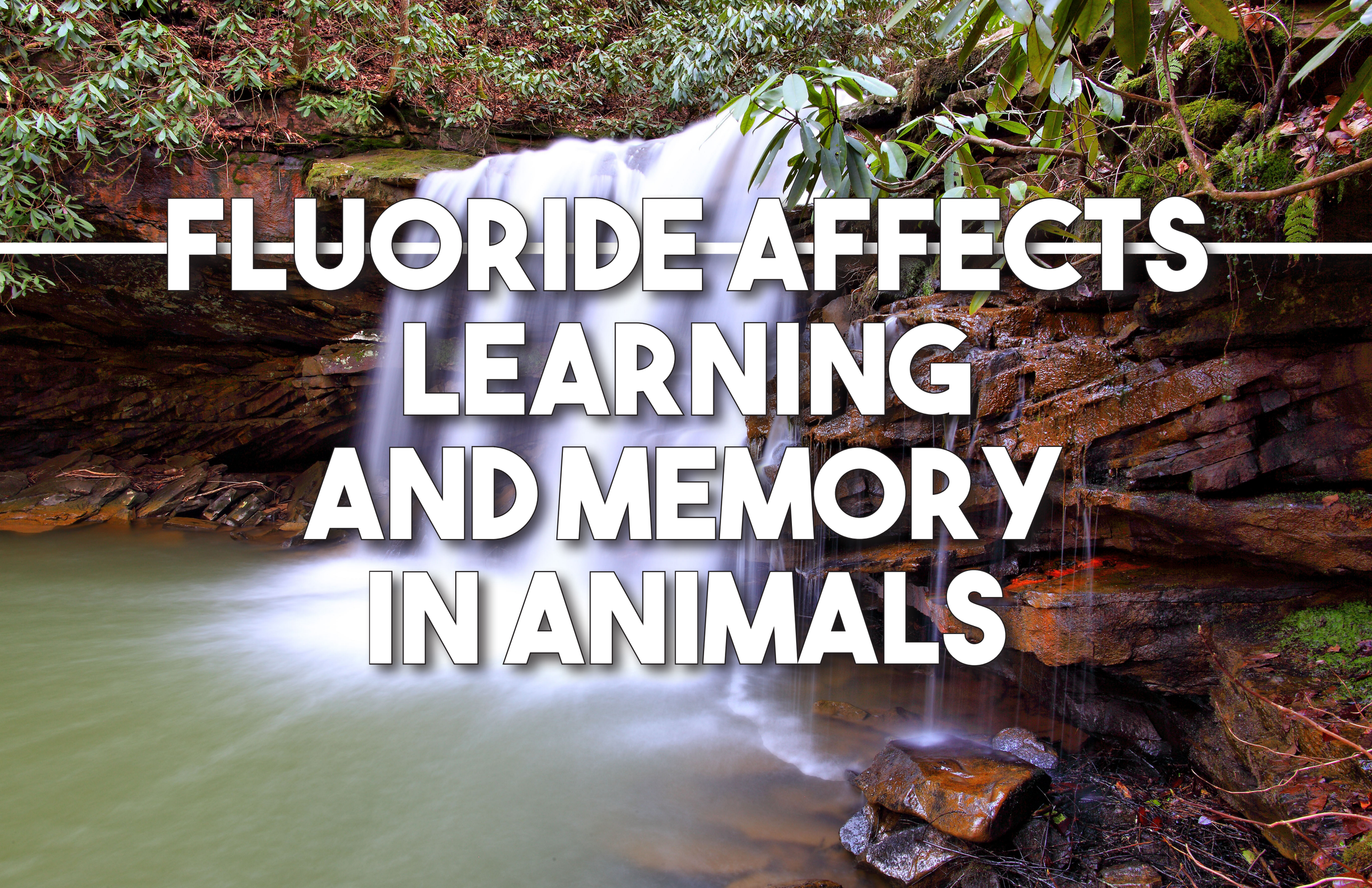
The researchers conducted a systematic review of studies, almost all of which are from China where risks from fluoride are well-established. Fluoride is a naturally occurring substance in groundwater, and exposures to the chemical are increased in some parts of China. Virtually no human studies in this field have been conducted in the U.S., said lead author Anna Choi, research scientist in the Department of Environmental Health at HSPH.

Even though many of the studies on children in China differed in many ways or were incomplete, the authors consider the data compilation and joint analysis an important first step in evaluating the potential risk. "For the first time we have been able to do a comprehensive meta-analysis that has the potential for helping us plan better studies. We want to make sure that cognitive development is considered as a possible target for fluoride toxicity," Choi said.

Choi and senior author Philippe Grandjean, adjunct professor of environmental health at HSPH, and their colleagues collated the epidemiological studies of children exposed to fluoride from drinking water. The China National Knowledge Infrastructure database also was included to locate studies published in Chinese journals. They then analyzed possible associations with IQ measures in more than 8,000 children of school age; all but one study suggested that high fluoride content in water may negatively affect cognitive development.

The average loss in IQ was reported as a standardized weighted mean difference of 0.45, which would be approximately equivalent to seven IQ points for commonly used IQ scores with a standard deviation of 15.* Some studies suggested that even slightly increased fluoride exposure could be toxic to the brain. Thus, children in high-fluoride areas had significantly lower IQ scores than those who lived in low-fluoride areas. The children studied were up to 14 years of age, but the investigators speculate that any toxic effect on brain development may have happened earlier, and that the brain may not be fully capable of compensating for the toxicity.

"*Fluoride seems to fit in with lead, mercury, and other poisons that cause chemical brain drain,*" Grandjean says. "*The effect of each toxicant may seem small, but the combined damage on a population scale can be serious, especially because the brain power of the next generation is crucial to all of us*."



FLUORIDE AFFECTS LEARNING AND MEMORY IN ANIMALS

An association between elevated fluoride exposure and reduced intelligence has now been observed in over 30 studies of human populations. Although a link between fluoride and intelligence might initially seem surprising or random, it is actually consistent with a large body of animal research. This animal research includes the following 31 studies where mice or rats treated with fluoride were found to suffer impairments in their learning and/or memory abilities. Although two animal studies have failed to find this association, (Whitford 2009; Varner 1994), the clear majority of both animal and human research indicates that fluoride can damage cognitive function.

Studies Finding An Effect On Learning And/Or Memory

"Conclusion: Neurobehavioral development as well as learning and memory ability in rat offspring are impaired by long-term exposure to fluoride and Vit E has exhibited an antagonistic effect to the toxicities of fluoride."

Source: Dong YT, et al. (2014). [Effects of chronic fluorosis on neurobehavioral development in offspring of rats and antagonistic effect of Vitamin E]. Chinese Journal of Endemiology 33(2):125-28.

"The behavior tests showed that 56 days of fluoride and lead administration significantly reduced the vertical activity and lowered the memory ability of mice.."

Source: Niu R, et al. (2014). Proteomic analysis of hippocampus in offspring male mice exposed to fluoride and lead. Biological Trace Element Research [Epub ahead of print].

"These data indicate that fluoride and arsenic, either alone or combined, can decrease learning and memory ability in rats. The mechanism may be associated with changes of glutamate level and mGluR5 expression in cortex and hippocampus."

Source: Jiang S, et al. (2014). Fluoride and Arsenic Exposure Impairs Learning and Memory and Decreases mGluR5 Expression in the Hippocampus and Cortex in Rats. PLoS One. 2014 Apr 23;9(4):e96041.

"Taken together, these results indicated that long-term fluoride administration can enhance the excitement of male mice, impair recognition memory, and upregulate VAMP-2 mRNA expression, which are involved in the adverse effects of fluoride on the object recognition memory of nervous system."

Source: Han H, et al. (2014). Effects of chronic fluoride exposure on object recognition memory and mRNA expression of SNARE complex in hippocampus of male mice. Biological Trace Element Research [Epub ahead of print]

"Collectively, our data indicate that developmental exposure to NaF induces cognitive deficits and anxiety-depression-like behaviors in mice."

Source: Liu F, et al. (2014). Fluoride exposure during development affects both cognition and emotion in mice. Physiology & Behavior 124:1-7.

"We found that NaF treatment impaired learning and memory in these rats. Furthermore, NaF caused neuronal degeneration, decreased brain glucose utilization, decreased the protein expression of glucose transporter 1 and glial fibrillary acidic protein, and increased levels of brain-derived neurotrophic factor in the rat brains. The developmental neurotoxicity of fluoride may be closely associated with low glucose utilization and neurodegenerative changes."

Source: Jiang C, et al. (2014). Low Glucose Utilization and Neurodegenerative Changes Caused by Sodium Fluoride Exposure in Rat's Developmental Brain. Neuromolecular Medicine 16(1):94-105.

"The results of the present study showed no behavioural deficits in the control group of animals however, the rats that received fluoride water exhibited impairment in their spatial learning and memory deficits. The deficits are not marked in the vitamin C and G. biloba groups. To conclude chronic exposure to high levels of fluoride causes severe impairment in the spatial learning and memory, these deficits can be ameliorated with the vitamin C and G. biloba."

Source: Jetti R, et al. (2013). Protective effect of ascorbic acid and Ginkgo biloba against learning and memory deficits caused by fluoride. Toxicology and Industrial Health. 2013 Sep 30. [Epub ahead of print]

"The Y-maze test has been widely used to evaluate cognitive abilities. The test involves recording the CRT [correct reaction time]. . . . The CRT of the NaF group on the 9th day decreased significantly ($p<0.01$, vs. control group). The CRT of the rats treated with EGb [ginko bilboa extract] significantly increased compared to the rats that received fluoride and saline ($p<0.01$). After 2 weeks, the Y-maze test was performed again to test the CRT. As showed in Fig. 1c, the CRT of the EGb group was significantly more than that of the NaF group ($p<0.01$). This result suggested that EGb could improve learning and memory impairment induced by chronic fluoride exposure in rats."

Source: Zhang C, et al. (2013). The analog of ginkgo biloba extract 761 is a protective factor of cognitive impairment induced by chronic fluorosis.Biological Trace Element Research 153:229-36.

"The learning and memory abilities were lower in chronic fluorosis groups, particularly in medium and high fluorosis groups ($P <0.05$ or $P <0.01$) than in the normal group. Compared with the normal group, marked morphological changes were observed in

the hippocampal cells in high fluorosis group. Conclusion: The rat model has a strong resemblance in cognitive dysfunction caused by chronic fluorosis to that in population of high fluorosis areas . . . ."

Source: Chen H, Deng G. (2012). [The establishment and assessment of animal model of chronic fluorosis-induced cognitive dysfunction in rats]. Acta Academiae Medicinae Xuzhou 31(5):319-22.

"In this study F-toxicated animals took more time (seconds) to reach the goal area (latency) and committed more number of errors during the criteria leading to a less number of correct choices (performance), subsequently more number of sessions were conducted to learn the task (acquisition) in T maze test. This impaired spatial memory performance might be due to F accumulation (retention) in brain areas especially in hippocampus, which triggered oxidative stress to higher fold contributing to cognitive deficits."

Source: Basha PM, Sujitha NS (2012). Combined impact of exercise and temperature in learning and memory performance of fluoride toxicated rats. Biological Trace Element Research 150:306-13.

"NaF induced motor incoordination, depression, and memory impairment, and these were prevented by coadministration of BM in mice."

Source: Balaji B, et al. (2012). Evaluation of standardized Bacopa monniera extract in sodium fluoride induced behavioural, biochemical, and histopathological alterations in mice. Toxicology and Industrial Health. 2012 Dec 6. [Epub ahead of print]

"The results demonstrate that fluoride exposure may develop an adverse effect on the learning capacity of rats, this may be caused by monoamine neurotransmitters levels alteration."

Source: Zhu Y, et al. (2012). Effects of fluoride exposure on performance in water labyrinth and monoamine neurotransmitters of rats. Journal of Xinjiang Medical University 35(3):330-33.

"The results showed that NaF impairs open-field habituation and increases noradrenaline (NA) and serotonin (5-HT) in the striatum, hippocampus and neocortex. Dopamine (DA) increase was restricted to the striatum. Short-term NaF withdrawal did not reverse these NaF-induced changes, and both NaF treatments led to a mild fluorosis in rat incisors. No treatment effect was seen in body weight or fluid/water consumption. These results indicate that sodium fluoride induces memory impairment that outlasts short-term NaF withdrawal (2 weeks) and may be associated with NA and 5-HT increases in discrete brain regions."

Source: Pereira M, et al. (2011). Memory impairment induced by sodium fluoride is associated with changes in brain monoamine levels. Neurotox Res. 19(1):55-62.

“In the T-maze experiments, the fluoride-treated group showed poor acquisition and retention and higher latency when compared with the control. The alterations were more profound in the third generation when compared with the first- and second-generation fluoride-treated group. Changes in the thyroid hormone levels in the present study might have imbalanced the oxidant/antioxidant system, which further led to a reduction in learning memory ability. Hence, presence of generational or cumulative effects of fluoride on the development of the offspring when it is ingested continuously through multiple generations is evident from the present study.”

Source: Basha PM, et al. (2011). Fluoride toxicity and status of serum thyroid hormones, brain histopathology, and learning memory in rats: a multigenerational assessment. Biol Trace Elem Res. 144(1-3):1083-94.

“The results showed that in the rat offspring exposed to higher fluoride as compared to controls, the learning and memory ability declined; the cholinesterase activities in the brains were inhibited; the protein levels of alpha3, alpha4 and alpha7 nAChR subunits were decreased which showed certain significant correlations with the declined learning and memory ability; and the mRNA levels of alpha3 and alpha4 nAChRs were decreased, whereas the alpha7 mRNA increased.”

Source: Gui CZ, et al. (2010). Changes of learning and memory ability and brain nicotinic receptors of rat offspring with coal burning fluorosis. Neurotoxicol Teratol. 32(5):536-41.

“Our results suggest that exposure of rats to Na-F in high doses for long duration has detrimental effects on the brain as reflected in diminished learning and memory.”

Source: El-Lethey H, et al. (2010). Neurobehavioral toxicity produced by sodium fluoride in drinking water of laboratory rats. Journal of American Science 6:54-63

“The results showed that as compared with controls, the learning and memory capacity in the rats with fluorosis was decreased. The protein expressions of alpha7 and alpha4 nAChR subunits in rat brains with fluorosis were decreased by 35% and 33%, whereas the corresponding receptor subunit mRNAs did not exhibit any changes. The increases of phospho- and total-ERK1/2 as well as phospho-MEK1/2 at the protein levels were found in the brains of rats with fluorosis as compared to controls, and no difference of ERK1/2 mRNA was found. In addition, the activation rate of phospho-ERK1/2 was decreased in the brains affected with fluorosis. The modifications of nAChRs and ERK1/2 pathway might be connected with the molecular mechanisms in the decreased capacity of learning and memory of the rats with fluorosis.”

Source: Liu YJ, et al. (2010). Alterations of nAChRs and ERK1/2 in the brains of rats with chronic fluorosis and their connections with the decreased capacity of learning and memory. Toxicol Lett. 192(3):324-9.

"Conclusion: Brick tea fluoride and aluminum poisoning of rats obstructs learning and memory and brain tissue SS expression decreases."

Source: Bai J, et al. (2010). Learning and memory obstacles and changes in brain tissue growth inhibitors from brick tea fluoride and aluminum poisoning of rats. Chinese Journal of Control of Endemic Diseases 25(3):161-63.

"The aim of this research was to study the mechanism of the decreased learning and memory of rats with chronic fluorosis. Compared with controls, decreased learning and memory ability, lower levels of total antioxidant capacity (TAOC), and increased content of malondialdehyde (MDA) in brain tissues were observed in both male and female young adult rats after 6 months with either 5 or 50 mg NaF/L in their drinking water. . . . The results indicate that the reduced learning capacity and memory ability of rats induced by F may be connected with increased oxidative stress and diminished cholinergic nervous system responses."

Source: Gao Q, et al. (2009). Decreased learning and memory ability in rats with fluorosis: increased oxidative stress and reduced cholinesterase activity in the brain. Fluoride 42(4):277-85.

"Objective: To explore the effects of fluoride in learning and memory changes and the antagonism of selenium by way of animal experiments. . . . Conclusion: Fluoride can damage the learning and memory function, and selenium may [mitigate these] effects."

Source: Gao Y, et al. (2009). [Effects of learning and memory of fluoride and the antagonism of selenium in rat.] [Study in Chinese] Studies of Trace Elements and Health 26(2).

"Conclusion: Passing through placental barriers, the fluorine exposure of pregnant rats can have a certain effect on the learning and memory capabilities of baby rats, and it may be related to SOD activity and MDA content in the brain."

Source: Zhang J, et al. (2009). The effect of fluorine exposure of pregnant rats on the learning and memory capabilities of baby rats. Chinese Journal of Public Health 25(11):1347-48.

“Results showed that the learning abilities and hippocampus glutamate levels were significantly decreased by [fluoride] and [lead] individually and the combined interaction of [fluoride] and [lead]. . . . These findings suggested that alteration of hippocampus glutamate by [fluoride] and/or [lead] may in part reduce learning ability in rats.”

Source: Niu R, et al. (2009). Decreased learning ability and low hippocampus glutamate in offspring rats exposed to fluoride and lead. Environ Toxicol Pharmacol. 28(2):254-8.

“Overall, these results suggest that moderate intoxication with sodium fluoride has potentially deleterious effects on learning and memory.”

Source: Chioca LR, et al. (2008). Subchronic fluoride intake induces impairment in habituation and active avoidance tasks in rats. European Journal of Pharmacology 579(1-3):196-201.

“Conclusion: The results indicate that chronic fluorosis has a significant effect on rat learning and memory behavior.”

Source: Wang G, et al. (2006). Effect of different doses of chronic exposure of fluoride on rat learning and memory behavior. Studies of Trace Elements & Health 23(2):1-2.

“Objective: To study the effect of high level fluoride and low level iodine on learning-memory in offspring rats and possible mechanism. . . . Results: Compared with control rats, error number (EN1) and (EN2) of the experimental offspring rats increased significantly (P0.05). Sustaining time (ST) reduced obviously (P0.05). EN1 and EN2 of the experimental rats in the group of high fluoride and low iodine were the highest in all groups (P0.05)..”

Source: Hong J, et al. (2005). [Effects of high fluoride and low iodine on learning-memory and TchE of brain in offspring rats]. China Preventive Medicine. Available online at: http://en.cnki.com.cn/Article_en/CJFDTOTAL-ZGYC200506000.htm

“In comparison with control rats, the learning and memory ability of the offspring rats was depressed by high fluoride, low iodine, or the combination of high fluoride and low iodine.”

Source: Wang J, et al. (2004). Effects of high fluoride and low iodine on biochemical indexes of the brain and learning-memory of offspring rats. Fluoride 37: 201-208.

“The learning memory abilities of rats in high F group, high I-high F group, and low I-high F group were significantly lower than control group, while the learning memory abilities of rats given proper concentration I and Se increased significantly.”

Source: Shen X, et al. (2004). [Effect of iodine and selenium on learning memory impairment induced by fluorosis and blood biochemical criterion of rats]. Occupation & Health 20(1):6-8.

"Fluoride intoxicated animals also performed poorly in motor co-ordination tests and maze tests. Inability to perform well increased with higher fluoride concentration in drinking water."

Source: Bhatnagar M, et al. (2002). Neurotoxicity of fluoride: neurodegeneration in hippocampus of female mice. Indian Journal of Experimental Biology 40: 546-54.

"Conclusion: Fluorosis of mice caused significant harm to some open field behavior and learning capabilities of mice, there was a certain effect on brain SOD activity, and this effect may have a certain relation to the fluoride concentration."

Source: Xu X, et al. (2001). Effect of fluorosis on mice learning and memory behaviors and brain SOD activity and MDA content. China Public Health 17(1):8-10.

"The main results showed that the learning capability of mice drinking higher concentration of fluoride presented remarkable deterioration."

Source: Zhang Z, et al. (2001). Effects of selenium on the damage of learning-memory ability of mice induced by fluoride. [Article in Chinese] Journal of Hygiene Research 30(3):144-146.

"Learning and memory abilities of high-fluoride exposed groups were significantly lower than that of the control group, while the brain ChE activities of high-fluoride exposed groups were significantly higher. Conclusions: High fluoride concentration in drinking water can decrease the cerebral functions of mice. Fluoride is a neurotoxicant."

Source: Sun ZR, et al. (2000). Effects of high fluoride drinking water on the cerebral functions of mice. Chinese Journal of Epidemiology 19: 262-263.

"The main results are as follows: the learning ability of mice drinking high concentration of fluoride presented remarkable deterioration… The results suggested that the impairment on the learning capability induced by fluorosis may be closely related with the pathological changes of synaptic structure in the brain of mice."

Source: Zhang Z, et al. (1999). Effect of fluoride exposure on synaptic structure of brain areas related to learning-memory in mice. Journal of Hygiene Research 28(4):210-2. (Republished in Fluoride 2008; 41:139-43.

"This is the first laboratory study to demonstrate that CNS functional output is vulnerable to fluoride, that the effects on behavior depend on the age at exposure and that fluoride accumulates in brain tissues. Experience with other developmental neurotoxicants prompts expectations that changes in behavioral function will be comparable across species, especially humans and rats. Of course behaviors per se do not extrapolate, but a generic behavioral pattern disruption as found in this rat study can be indicative of a potential for motor dysfunction, IQ deficits, and/or learning disabilities in humans."

Source: Mullenix P, et al. (1995). Neurotoxicity of Sodium Fluoride in Rats. Neurotoxicology and Teratology 17(2):169-177.

Building a Database
of Developmental Neurotoxicants:
Evidence from Human and Animal Studies
The Environmental Protection Agency

EPA's program for the screening and prioritization of chemicals for developmental neurotoxicity makes it essential to assemble a list of chemicals that are toxic to the developing mammalian nervous system. Listed chemicals will be used to evaluate the sensitivity, reliability, and predictive power of alternative developmental neurotoxicity assays. To establish this list, a literature review was conducted for over 400 compounds that have been suggested to be developmental neurotoxicants, neurotoxicants, or developmental toxicants. Compounds were assigned one of three groups based on the strength of the evidence for developmental neurotoxicity:

(1) no evidence: either there were no reports that met our criteria for evidence, or there were reports which showed no developmental neurotoxicity;

(2) minimal evidence: one report only or multiple reports from only one laboratory; or administered dose would not be lethal to the offspring.

(3) substantial evidence: reports from more than one laboratory.

Chemicals with **Substantial** Evidence of Developmental Neurotoxicity (n≈**100**)

2-Ethoxyethyl Acetate
Acibenzolar-*S*-methyl
Acrylamide
Aldicarb
Allethrin
Aluminum (cl or lactate)
Amino-nicotinamide(6-)
Aminopterin
Amphetamine(*d*-)
Arsenic
Aspartame
Azacytidine(5-)
Benomyl
Benzene
Bioallethrin
Bis(tri-n-butyltin)oxide
Bisphenol A
Bromodeoxyuridine(5-)
Butylated Hydroxy Anisol
Butylated hydroxytoluene
Cadmium
Caffeine
Carbamazepine
Carbaryl
Carbon monoxide
Chlordecone
Chlordiazepoxide
Chlorine dioxide
Chlorpromazine
Chlorpyrifos
Cocaine
Colcemid
Colchicine
Cypermethrin
Dexamethasone
Diamorphine hydrochloride
Diazepam
Cytosine Arabinoside
DEET
Deltamethrin
Diazinon
Dieldrin
Diethylstilbestrol
Diphenylhydantoin
Epidermal Growth Factor
Ethanol
Ethylene thiourea
Flourouracil(5-)
Fluazinam
Fluoride
Griseofulvin
Haloperiodol
Halothane
Heptachlor
Hexachlorobenzene
Hexachlorophene
Hydroxyurea
Imminodiproprionitrile (IDPN)
Ketamine
Lead
Lindane
LSD
Maneb
Medroxyprogesterone
Mepivacaine
Methadone
Methanol
Methimazole
Methylparathion
Monosodium Glutamate
MPTP
Naloxone
Naltrexone
Nicotine
Methoxyethanol, 2-
Methylazoxymethanol
Methylmercury
Ozone
Paraquat
Parathion (ethyl)
PBDEs
PCBs (generic)
Penicillamine
Permethrin
Phenylacetate
Phenylalanine (d,l)
Phthalate, di-(2-ethylhexyl)
Propylthiouracil
Retinoids/vit.A/isotretinoin
Salicylate
Tebuconazole
Tellurium (salts)
Terbutaline
Thalidomide
THC
Toluene
Triamcinolone
Tributyltin chloride
Trichlorfon
Trichloroethylene
Triethyllead
Triethyltin
Trimethyltin
Trypan blue
Urethane
Valproate
Vincristine

RACIAL DISPARITIES IN DENTAL FLUOROSIS

Racial Disparities In Dental Fluorosis

In 2005, the Centers for Disease Control published the results of a national survey of dental fluorosis conducted between 1999 and 2002. According to the CDC, black children in the United States have significantly higher rates of dental fluorosis than either white or Hispanic children. As the CDC noted, this was not the first time that black children were found to suffer higher rates of dental fluorosis. Indeed, as documented below, at least five other studies — dating as far back as the 1960s — have found black children in the United States are disproportionately impacted by dental fluorosis.

Not only do black children have higher rates of fluorosis, they have more severe forms of the condition. A 2010 study from fluoridated Indianapolis found that over 12% of surveyed black children, but none of the surveyed white children, had pitting (*a definite physical defect of the enamel*) as a result of too much fluoride exposure. (Martinez-Mier 2010). Similarly, a 1990 study from Georgia found that over 16% of black children (*versus 9% of white children*) had moderate or severe fluorosis, involving either "*light to very dark brown*" staining, pitting; and/or "*large areas*" of "*missing*" enamel with "*dark-brown stain*" and "*altered*" tooth structure. (Williams & Zermer 1990).

It is not yet known why blacks suffer higher rates of dental fluorosis. According to the CDC, it may be a result of " biologic susceptibility or greater fluoride intake." (CDC 2005). Whatever the explanation, it is clear that the black community is being disproportionately harmed by current fluoride policies in the United States.

Martinez & Meir 2010
Fluorosis Survey In Indianapolis, Indiana

A fluorosis survey was conducted among 83 black children and 102 white children in Indianapolis, Indiana (a fluoridated community). As noted by the authors, "*the prevalence [of dental fluorosis] in African American children (80.1 percent) was significantly higher than in Whites (62.5 percent)*." Not only was the fluorosis rate higher in the black community, but the severity of the fluorosis was significantly greater ($P < 0.001$). Whereas the maximum fluorosis score in the white community registered as a two on the TSIF Scale, the maximum fluorosis score in the black community registered as a five. A TSIF score of two refers to teeth with white staining covering "*at least one-third of the visible surface, but less than two-thirds.*" A TSIF score of five refers to pitting of the enamel, which is defined as "*a definite physical defect in the enamel surface*" which "*is usually stained or differs in color from the surrounding enamel.*"

Centers For Disease Control
National Survey of Dental Fluorosis 1999-2002

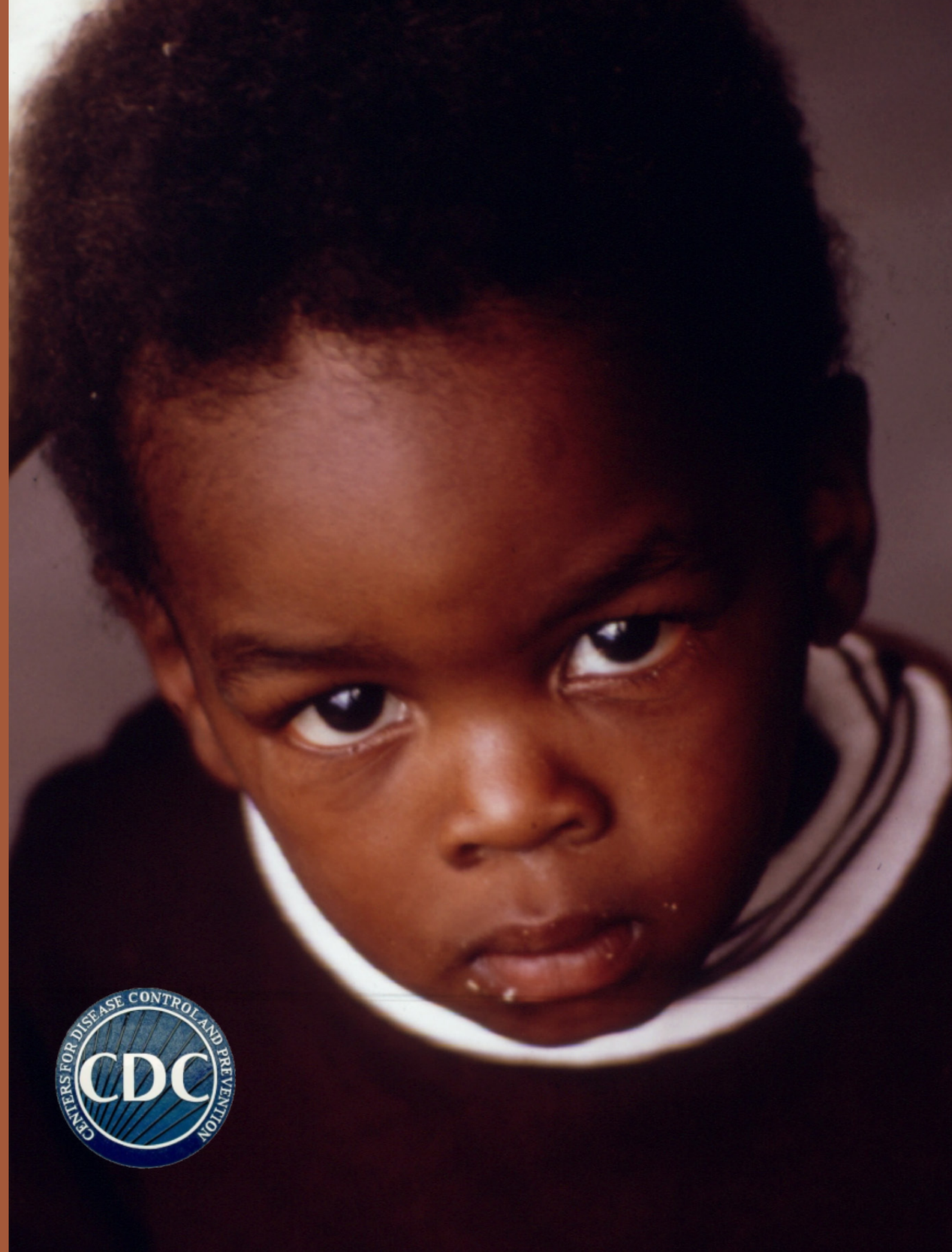
This study by the CDC provides national fluorosis data from the 1999-2002 NHANES survey.
As noted by the CDC:

"*Non-Hispanic blacks had higher proportions of very mild and mild fluorosis than did non-Hispanic white participants. No clear explanation exists why fluorosis was more severe among non-Hispanic black children than among non-Hispanic white or Mexican-American children. This observation has been reported elsewhere, and different hypotheses have been proposed, including biologic susceptibility or greater fluoride intake.*"

SOURCE: Beltran-Aguilar ED et al. (2005). Surveillance for dental caries, dental sealants, tooth retention, edentulism, and enamel fluorosis — United States, 1988–1994 and 1999—2002. MMWR Surveillance Summaries 54(3): 1-44.

The following chart provides the fluorosis rates for each racial group. As can be seen, the rate of moderate/severe dental fluorosis in the black community is almost twice as high as the rate in the white community (3.43% vs. 1.92%) and the rate of mild fluorosis is more than twice as high (8.24% vs. 3.87%). It is important to bear in mind when viewing this data that these figures are the national average, and thus include fluoridated and unfluoridated communities. Were the data limited to fluoridated communities, the fluorosis rates for all racial groups would be higher. The rates would also be higher if the chart excluded adults. For, as the chart shows, children and adolescents have higher fluorosis rates than the adults (*due to the increase in fluoride exposure amongst the younger generation*).

	Unaffected		Very mild		Mild		Moderate/Severe	
Characteristic	%†	SE§	%	SE	%	SE	%	SE
Age group (yrs)								
6–11	59.81	4.07	19.85	2.12	5.83	0.73	2.71	0.59
12–15	51.46	3.51	25.33	1.98	7.68	0.93	3.56	0.59
16–19	58.32	3.30	20.79	1.78	6.65	0.67	4.03	0.77
20–39	74.86	2.28	11.15	1.22	3.34	0.58	1.81	0.39
Sex								
Male	67.65	2.63	15.65	1.52	4.58	0.54	2.12	0.39
Female	66.97	2.84	15.58	1.36	4.84	0.61	2.78	0.49
Race/Ethnicity¶								
White, non-Hispanic	69.69	3.13	14.09	1.56	3.87	0.60	1.92	0.48
Black, non-Hispanic	56.72	3.30	21.21	2.16	8.24	0.82	3.43	0.54
Mexican-American	65.25	3.89	15.93	2.24	5.05	0.72	4.82**	1.81
Poverty status††								
<100% FPL	68.02	3.21	14.28	1.73	4.07	0.69	2.97	0.66
100%–199% FPL	66.92	2.91	16.11	1.46	5.21	0.78	2.65	0.56
≥200% FPL	66.88	2.75	15.56	1.56	4.83	0.50	2.00	0.37
Total	**67.40**	**2.65**	**15.55**	**1.37**	**4.69**	**0.49**	**2.45**	**0.40**



Kumar 1999, 2000
Fluorosis Survey In Newburgh & Kingston, NY

These two studies report the results of a fluorosis survey of children in a fluoridated (Newburgh) and unfluoridated (Kingston) town in New York. In both the fluoridated and unfluoridated communities, black children were found to have higher rates of dental fluorosis. Specifically, being black doubled the odds of getting very mild to severe dental fluorosis (odds ratio = 2.3). According to the authors:

"African-American children studied in 1995 were at higher risk for dental fluorosis than children of other racial groups. . . . The higher risk for dental fluorosis observed among African-American children is consistent with several other studies. Russell noted that dental fluorosis was twice as prevalent among African-American children than white children in the Grand Rapids fluoridation study. Because this study was conducted in an era when other sources of fluoride products were not available, this finding suggests either that fluorosis is more likely to occur in African-American children due to biologic susceptibility, or that their fluoride intake was greater."

Source: Kumar JV, Swango PA. (1999). Fluoride exposure and dental fluorosis in Newburgh and Kingston, New York: policy implications. Community Dentistry & Oral Epidemiology 27:171-80.

After finding higher rates of fluorosis in the black community, the authors attempted to determine if the rate could be explained by low-birth weight. In their follow-up analysis in 2000, the authors again found higher rates of fluorosis among black children. The higher rate, however, was not explained by low birth weight. According to the authors:

"The results support our earlier findings that African-American children were at higher risk for dental fluorosis in the fluoridated area. Even in the nonfluoridated area, there was a suggestion that African-American children were at higher risk. Whether this higher risk for African-American children is the result of their lower threshold for fluoride or due to other unknown sources of fluoride is not known. It has been reported that African-American children in the United States drink more water and less milk compared to white children. In Newburgh, this difference in the fluid consumption may have resulted in a higher prevalence of fluorosis in African-American children. . . . Because a race fluorosis association could have important policy implications, a large-scale study in a representative sample should be conducted to test specifically the hypothesis that African-American children are at higher risk for fluorosis."

Source: Kumar JV, Swango PA. 2000. Low birth weight and dental fluorosis: is there an association? Journal of Public Health Dentistry 60(3):167-71.

Williams & Zermer 1990
Fluorosis Survey In Georgia

In this study, the authors examined the rate of fluorosis in 374 children with lifelong residence in two fluoridated areas of Georgia: Augusta (0.9 to 1.2 mg/l) and Richmond County (0.2 to 0.9 mg/l). The authors found a very high fluorosis rate (81%) among the children in fluoridated Augusta, with 14% of the children having moderate or severe fluorosis. The fluorosis rate in Richmond County (54%) was also high. The authors attributed the high fluorosis rate to inappropriate fluoride supplementation by local pediatricians and dentists, as well as an increase in overall fluoride exposure from other sources. As the following table shows, black children were found to have higher rates of moderate/severe fluorosis (TSIF score of 4 to 7) in both communities. A TSIF score of 4 refers to teeth with "light to very dark brown" staining, a TSIF score of 5 refers to teeth with a "definite physical defect" (pitting); and a TSIF score of 7 refers to teeth where "large areas of enamel may be missing and the anatomy of the tooth may be altered. Dark-brown stain is usually present." As the table shows, 16.7% of black children in Augusta had moderates/severe fluorosis versus 9.1% of white children. In Richmond County, the respective rates were 3.3% vs 0%.

Dental Fluorosis Rates in Augusta & Richmond County, Georgia

Residence/Race	**No Fluorosis** (TSIF Score = 0)	**Very Mild/Mild Fluorosis** (TSIF Score = 1 – 3)	**Moderate/Severe Fluorosis** (TSIF Score = 4 – 7)
City/**Black**	19.6%	63.7%	**16.7%**
City/White	18.2%	72.7%	9.1%
County/**Black**	47.8%	48.9%	**3.3%**
County/White	44.9%	55.1%	0%

SOURCE: Williams JE, Zwemer JD. (1990). Community water fluoride levels, preschool dietary patterns, and the occurrence of fluoride enamel opacities. *Journal of Public Health Dentistry* 50:276-81.

Butler 1985
Fluorosis Survey
In 16 Texas Communities

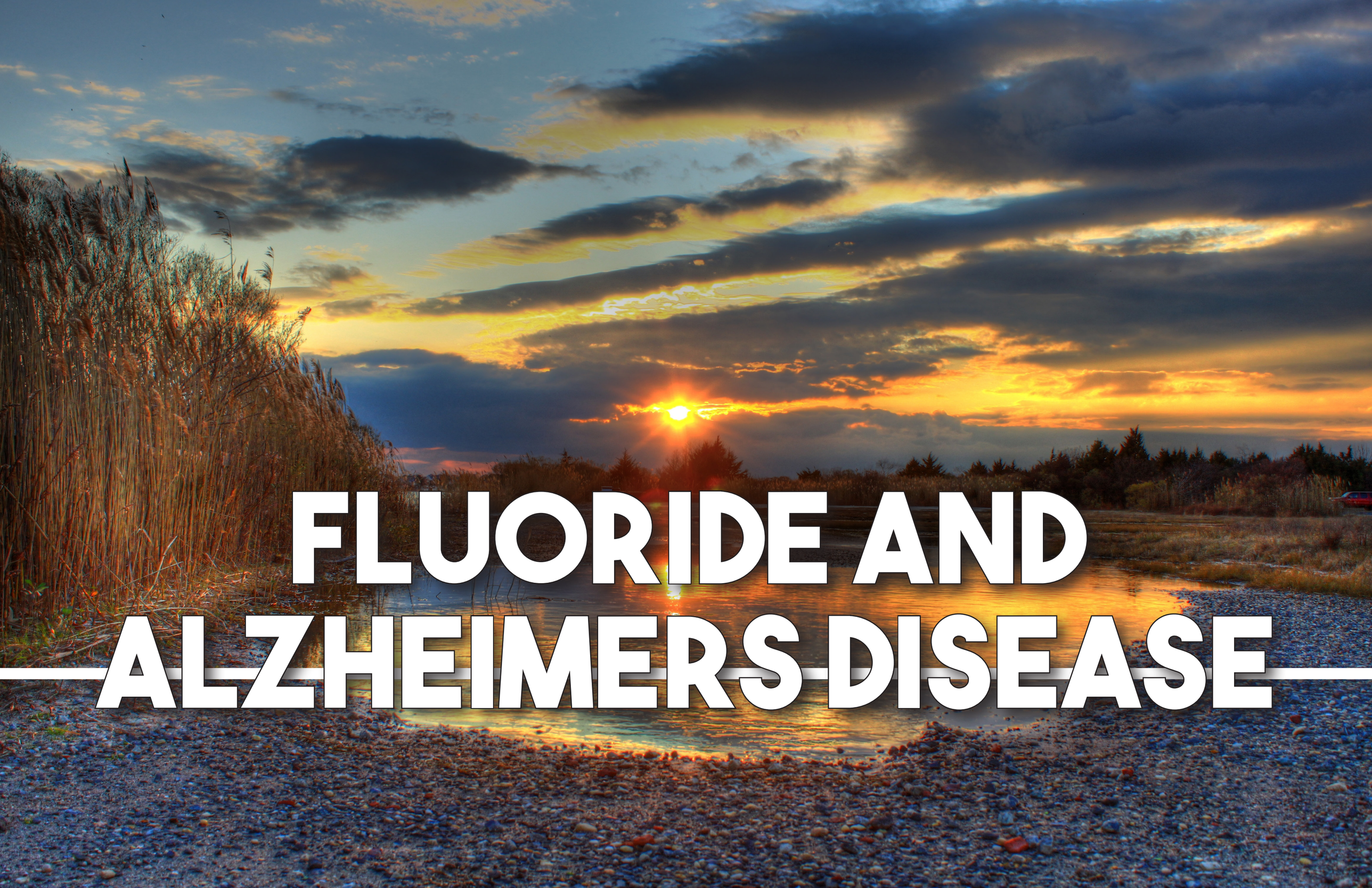
"The severity of dental mottling in 2,592 school-aged, lifetime residents of 16 Texas communities was investigated in 1980-81 to identify factors associated with mottling and to construct a prediction model for the prevalence of mottling. The communities were selected to obtain a wide range of levels of fluoride in the drinking water. The children within each of the communities were contacted through their schools and received a dental examination to assess the severity of mottling. Information on demographic, dental health practice, and other candidate predictor variables was obtained from a questionnaire completed by a parent. A number of water quality measurements were also recorded for each community. White and Spanish-surname children had about the same prevalence of mottling while Blacks had a higher prevalence, odds ratio (OR) = 2.3, 95% confidence interval = 1.4, 3.7."

Source: Butler WJ, et al. (1985). Prevalence of dental mottling in school-aged lifetime residents of 16 Texas communities. American Journal of Public Health 75:1408-1412.

Russell 1962
Fluorosis Survey
In Grand Rapids, Michigan

"Russell (1962), in the Grand Rapids fluoridation study, noted that fluorosis was twice as prevalent among African-American children than white children."

Source: National Research Council. (1993). Health effects of ingested fluoride. National Academy Press, Washington DC. p. 44.



FLUORIDE AND ALZHEIMERS DISEASE

Alzheimer's Disease Linked to Pineal Gland Calcification from Fluoride

Alzheimer's disease is running rampant throughout the modern world now, but even with pharmaceutical companies spending billions on drugs to 'cure' it, they have failed miserably. While the use of coconut oil for Alzheimer's disease is proving beyond beneficial, the answer to really treating this disease may lie in the pineal gland and the decalcification of one of the most important elements of the endocrine system.

For the past few decades, research into treating Alzheimer's disease has been relegated to an assumption: that it is caused by the lack of the neurotransmitter, acetylcholine. In fact, most pharmaceuticals made to treat Alzheimer's patients are acetylcholinesterase inhibitors (drugs that inhibit the enzyme that breaks this neurotransmitter down.)

Big Pharma Fails to Treat Alzheimer's

These drugs have produced only palliative results, if any, and many of them cause seizures or other neurological issues in the patients who take them. As Sayer Ji from GreenMedInfo so convincingly points out, Alzheimer's drugs are nothing but patented xenobiotic chemicals, completely alien to human physiology. So – if this is the case, it makes sense to look deeper into the causes of such a prevalent disease which is said to be 'bigger than cancer' for the pharmaceutical markets. Despite failed trials, Big Pharma continues to invest heavily in 'cures' that may not do anything but worsen the disease.

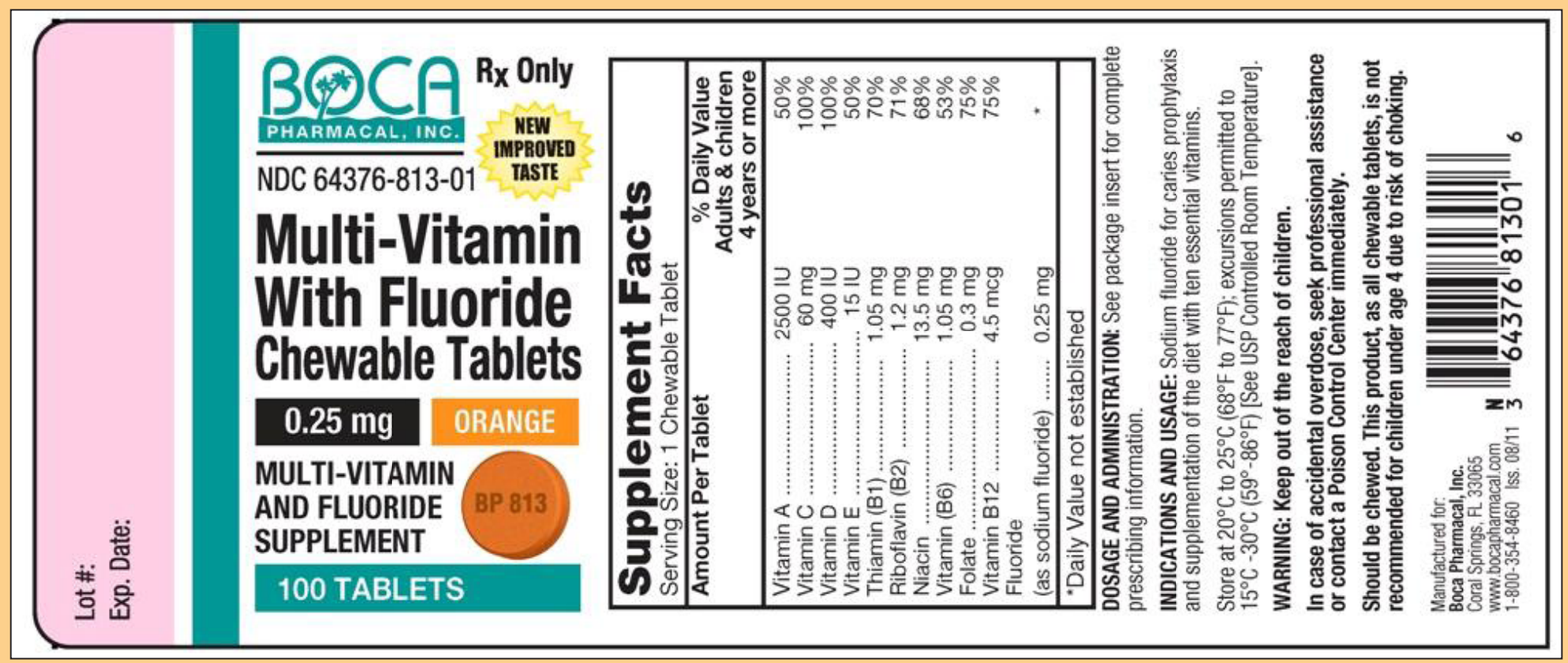
For instance, trials of Eli Lilly's gamma-secretase inhibitor, semagacestat (LY450139), were halted due to below par results. Later, despite reports that results of solanezumab, a neuroprotector that binds to plaque and inhibits its formation, were positive, the company said that it was not going to the FDA for approval, but will conduct a third Phase III trial. The company has already failed three times at creating a "inhibitor that would address this disease effectively."

These attempts are in the company of other failed pharmaceutical projects

• In 2011, Bristol-Myers Squibb tried to develop a gamma-secretase inhibitor (BMS-708163. Test results were less than promising.

• In 2012, Pfizer announced that it was abandoning further development of intravenous formulations of bapineuzumab, an anti-amyloid antibody, after the failure of its Phase II study.

• In 2013, Baxter International reported that its immune-bolstering treatment had ended in a failure after trying to create a drug called Gammagard out of components of the human immune system. It also failed at removing amyloid plaques from the brain.



Research Reveals Link Between Calcification of the Brain and Alzheimer's Disease

A new study looks at intracranial calcifications in the brains of Alzheimer's patients. After noticing that the brain's primary structures were negatively affected by calcification, namely the pineal gland, habenula, choroids plexus, superior sagittal sinus, basal ganglia, falx, dura mater, and tentorium cerebelli, as well as the petroclinoid ligaments, a promising new hypothesis was formed.

Removing calcification from the brain could treat the disease

Alzheimer's patients had highly calcified pineal glands, as do two-thirds of the adult population, and a likely cause of this calcification is fluoride.

"Fluoride is likely to cause decreased melatonin production and to have other effects on normal pineal function, which in turn could contribute to a variety of effects in humans." (National Research Council 2006).

Alzheimer's disease patients are commonly deficient in melatonin levels, likely due to the inability of their pineal gland to produce adequate quantities. The pineal gland is responsible for regulating melatonin and seratonin, which are precursors to N,N-Dimethyltryptamine, or DMT. Melatonin is secreted at night and our pineal gland is aided in this process by sleeping in complete darkness, which is how melatonin production is best synthesized. Our endogenous melatonin levels usually peak around 2 AM, and ceases when the sun comes up.

By the time most people are 17 years old, their pineal glands are calcified, thus greatly reducing this gland's ability to create melatonin. Their pineal glands will often appear as a lump of calcium during a magnetic resonance scan. Calcification is the buildup of calcium phosphate crystals in various parts of the body, a natural process caused primaily by nanobacteria.

Nanobacteria are tiny microorganisms that form calcium phosphate shells around themselves, essentially to protect themselves from your immune system. It appears from the latest research that this may be the cause of much of disease. From arthritis, to stroke, from cancer to back pain – and now Alzheimer's disease.

The International Center for Nutritional Research supports this new hypothesis that calcification of the pineal gland can be causing Alzheimer's disease:

"Fluoride does not accumulate in brain. Of all tissues, brain has the lowest fluoride concentration [Jenkins, 1991; Whitford, 1996; Ekstrand, 1996]. It is generally agreed that the blood-brain barrier restricts the passage of fluoride into the central nervous system (in adults). The human pineal gland is outside the blood-brain barrier [Arendt, 1995].

It is one of a few unique regions in the brain (all midline structures bordering the third and fourth ventricles) where the blood-brain barrier is weak. Cells in these regions require direct and unimpeded contact with blood [Rapoport, 1976]. Therefore, pinealocytes have free access to fluoride in the bloodstream. This fact, coupled with the presence of HA, suggest that the pineal gland may sequester fluoride from the bloodstream."

In fact, Alzheimer's patients have been observed to have a higher degree of pineal gland calcification than patients with other types of dementia, and sleep disturbances have been identified as a primary cause of Alzheimer's disease pathogenesis, due to the fact that wakefulness increases the toxic Alzheimer's disease associated brain protein — amyloid-β (Aβ), known as amyloid plaques – and sleep reduces Aβ. Melatonin has also been known to inhibit the progression of Aβ brain pathology as well as the formation of Aβ protein itself.

So while pharmaceutical companies spend billions on ways to stop amyloid plaque buildup, they aren't looking at the root cause of the calcification of the pineal gland which inhibits melatonin production, which is the body's own natural way to inhibit amyloid plaques.

Pineal Gland

"Fluoride is likely to cause decreased melatonin production and to have other effects on normal pineal function, which in turn could contribute to a variety of effects in humans." (National Research Council 2006).

In the 1990s, a British scientist, Jennifer Luke, discovered that fluoride accumulates to strikingly high levels in the pineal gland. (Luke 2001). The pineal gland is located between the two hemispheres of the brain and is responsible for the synthesis and secretion of the hormone melatonin. Melatonin maintains the body's circadian rhythm (sleep-wake cycle), regulates the onset of puberty in females, and helps protect the body from cell damage caused by free radicals.

While it is not yet known if fluoride accumulation affects pineal gland function, preliminary animal experiments found that fluoride reduced melatonin levels and shortened the time to puberty. (Luke, 1997). Based on this and other evidence, the National Research Council has stated that "fluoride is likely to cause decreased melatonin production and to have other effects on normal pineal function, which in turn could contribute to a variety of effects in humans" (NRC, 2006, p. 256).

The Pineal Gland Has The Highest Levels Of Fluoride In The Body

As a calcifying tissue that is exposed to a high volume of blood flow, the pineal gland is a major target for fluoride accumulation in humans. In fact, the calcified parts of the pineal gland (hydroxyapatite crystals) contain the highest fluoride concentrations in the human body (up to 21,000 ppm F), higher than either bone or teeth. (Luke 1997; 2001). Although the soft tissue of the pineal does not accumulate fluoride to the same extent as the calcified part, it does contain higher levels of fluoride than found than in other types of soft tissue in the body — with concentrations (~300 ppm F) that are known in other contexts to inhibit enzymes. While the impacts of these fluoride concentrations in the pineal are not yet fully understood, studies have found that calcified deposits in the pineal are associated with decreased numbers of functioning pinealocytes and reduced melatonin production (Kunz et al., 1999) as well as impairments in the sleep-wake cycle. (Mahlberg 2009).

Fluoride and Earlier Puberty in Girls

In the United States, children are reaching the age of puberty at earlier ages than in the past — a trend that carries health consequences, including a heightened risk for breast cancer. Some evidence indicates that fluoride, via its

effect on the pineal, could be a contributing cause to this trend. In animal studies, for example, fluoride exposure has been found to cause a decrease in the amount of circulating melatonin and lead to an accelerated sexual maturation in females. (Luke 1997). Similar findings have been reported in two epidemiological studies of human populations drinking fluoridated water. In the first published fluoridation safety experiment in Newburgh, New York, the authors found that girls living in a fluoridated community reached puberty five months earlier than girls living in a non-fluoridated community. (Schlesinger 1956) Later, in 1983, Farkas reported that postmenarcheal girls were "present at younger ages in the higher fluoride town than in the low-fluoride town, although the reported median ages were the same."

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CURRENT PEER REVIEWED REPORTS AND STUDIES ON FLUORIDE

European Journal of Oral Science
March 17, 2015

The in vitro impact of toothpaste extracts on cell viability

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Abstract

Toothpastes contain three main components: detergents, abrasives, and fluoride. Detergents, particularly sodium lauryl sulfate, have been proposed as components that enable toothpastes to produce cytotoxic effects in vitro. However, not all toothpastes contain sodium lauryl sulfate, and almost no studies have found an association between detergents and the in vitro cytotoxicity of toothpastes. The present study examined the in vitro cytotoxicity of nine commercially available toothpastes containing four different detergents. Toothpastes were diluted in serum-free medium, centrifuged, and filter sterilized. The half-lethal concentration of the toothpaste-conditioned medium (TCM) was calculated based on the formation of formazan by gingival fibroblasts, oral squamous cell carcinoma HSC-2 cells, and L929 cells. Cell proliferation was analyzed, and live-dead staining was performed, after exposure of cells to conditioned medium prepared with 1% toothpaste (1% TCM). It was found that toothpastes containing sodium lauryl sulfate and amine fluoride strongly inhibited cell viability with the half-lethal concentration being obtained with conditioned medium prepared with approximately 1% toothpaste (1% TCM). Toothpastes containing cocamidopropyl betaine and Steareth-20 showed higher half-lethal concentration values, with the half-lethal concentration being obtained with conditioned medium prepared with 10% (10% TCM) and 70% (70% TCM) toothpaste, respectively. Proliferation and live-dead data were consistent with the cell-viability analyses.

These results demonstrate that the type of detergent in toothpastes can be associated with changes in in vitro cell toxicity.

Link: http://www.ncbi.nlm.nih.gov/pubmed/25782087

Biological Trace Element Research
March 1, 2015

Effect of Sodium Fluoride on the Proliferation and Gene Differential Expression in Human RPMI8226 Cells

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Abstract

Although fluoride is known to reduce the incidence of caries, chronic excessive fluoride exposure can impair human health, even resulting in fluorosis. Now the underlying mechanisms of fluoride-induced toxicity are not fully understood. So, we conducted this study with the purpose of investigating the effect of sodium fluoride (NaF) in human RPMI8226 cells. In this experiment, human RPMI8226 cells were cultured with varied doses of fluoride (10, 20, 40, 80, 160, 320 μM). After 48 h exposure, the change of cell viability was examined by CCK-8 assay, and also the messenger RNA (mRNA) expression of relevant genes was assessed by QRT-PCR. Compared to the control group, fluoride exposure increased the human RPMI8226 cells viability at relatively lower levels (10-160 μM); however, when the concentration reached to 320 μM, the cell proliferation was significantly inhibited ($p < 0.05$). In addition, the genes mRNA expression, including ANKRD1, CRSP6, KLF2, SBNO2, ZNF649, FANCM, PDGFA, RNF152, CDK10, and CETN2 changed in a concentration-dependent manner and increased with fluoride exposure concentration. The results suggest that overexposure to fluoride (160-320 μM) can induce cytotoxicity and regulate relevant genes expression. Our findings provide novel insights into the mechanisms of action of fluoride-induced toxicity.

The results suggest that overexposure to fluoride (160-320 μM) can induce cytotoxicity and regulate relevant genes expression.

Link: http://www.ncbi.nlm.nih.gov/pubmed/25726004

Pathophysiology
March 22, 2015

Interplay of glia activation and oxidative stress formation in fluoride and aluminium exposure

Akinrinade ID, Memudu AE, Ogundele OM, Ajetunmobi OI

Abstract

Oxidative stress formation is pivotal in the action of environmental agents which trigger the activation of glial cells and neuroinflammation to stimulate compensatory mechanisms aimed at restoring homeostasis.

Aim

This study sets to demonstrate the interplay of fluoride (F) and aluminium (Al) in brain metabolism. Specifically, it reveals how oxidative stress impacts the activation of astrocytes (GFAP), mediates proinflammatory responses (microglia and B-cells: CD68 and CD 20 respectively) and shows the pattern of lipid peroxidation in the brain following fluoride and (or) aluminium treatment in vivo.

Method

Male adult Wistar rats were treated with low and high doses of fluoride, aluminium or combination of fluoride-aluminium for 30 days. The control group received distilled water for the duration of the treatment. Blood and brain tissue homogenates were prepared for colorimetric assay of stress biomarkers [malonialdehyde (MDA) and superoxide dismutase (SOD)]. Subsequent analysis involved immunodetection of astrocytes (anti-GFAP), microglial (anti-CD68) and B-cells (anti-CD20) in coronal sections of the prefrontal cortex using antigen retrieval immunohistochemistry.

Result & Conclusion

Aluminium, fluoride and a combination of aluminium-fluoride treatments caused an increase in brain lipid peroxidation products and reactive oxygen species (ROS) formation. Similarly, an increase in glial activation and inflammatory response were seen in these groups versus the control. Oxidative stress induced glial activation (GFAP) and increased the expression of B cells (CD20). This also corresponded to the extent of tissue damage and lipid peroxidation observed. Taken together, the results suggest a close link between oxidative stress neuroinflamation and degeneration in aluminium-fluoride toxicity.

Taken together, the results suggest a close link between oxidative stress, neuroinflamation and degeneration in aluminium-fluoride toxicity

Link: http://www.ncbi.nlm.nih.gov/pubmed/25577494

Romanian Journal of Morphology and Embryology - 2014

Histopathological changes of renal tissue following sodium fluoride administration in two consecutive generations of mice - Correlation with the urinary elimination of fluoride

Dimcevici Poesina N1, Bălălău C, Nimigean VR, Nimigean V, Ion I, Baconi D, Bârcă M, Băran Poesina V.

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Abstract

The present study was designed to investigate the toxic effects (evaluated as histopathological changes) of sodium fluoride on the kidney in two consecutive generations of NMRI mice. An attempt to correlate the toxicity with the urinary elimination of fluoride has been made, as urinary fluoride excretion has been widely used as an indicator of fluoride intake and exposure. Six mixed (males and females) animal groups have been constituted by dividing the populations of mice derived from pregnant females (named “mothers” 0.5 mg sodium fluoride) treated with 0.5 mg sodium fluoride by daily gavage and pregnant females (named “mothers” 0.25 mg sodium fluoride) treated with 0.25 mg sodium fluoride by daily gavage; three types of sodium fluoride treatments were administrated: homeopathic, allopathic-homeopathic and allopathic. When the animals reached the adulthood, by randomization, they were selected in pairs for giving birth to the second generation of mice. No treatments were administrated to the second generation of mice; thus, the urinary elimination of fluoride in the second generation is attributed to exposure at sodium fluoride before birth. The administration of sodium fluoride to the first generation (F1) is realized until the mice reached the adulthood. For the first generation, the urine was collected at three times, every three weeks: at the age of four weeks, seven weeks and 11 weeks; single sampling urine, at the age of four weeks, has been conducted for the second generation. The urine samples have been analyzed using the ion selective electrode method for fluoride. For the histopathological examination, the animals were killed by cervical dislocation; the kidneys were collected in a 10% formalin solution. The preparation of samples for optical microscopy was realized with Hematoxylin-Eosin staining. The results indicate that the elimination of fluoride was similar (at the second evaluation, at 7-week-old of the first generation) for the both generations of mice. Histopathological observation of the kidney has revealed granular dystrophy of the renal tubules, necrosis of the endothelial cells and of the mesangial cells of renal glomerulus. The study indicates that different sodium fluoride treatments produce some pathological aspects of the kidneys and influence the urinary elimination of fluoride in two consecutive generations of mice. For the higher doses, the pathological changes of the kidney are more important, and the urinary elimination of fluoride is higher, especially for the allopathic doses.

The study indicates that different sodium fluoride treatments produce some pathological aspects of the kidneys and influence the urinary elimination of fluoride in two consecutive generations of mice

Link: http://www.ncbi.nlm.nih.gov/pubmed/24969984

Food and Chemical Toxicology
August 2014

Protective effect of resveratrol on sodium fluoride-induced oxidative stress, hepatotoxicity and neurotoxicity in rats

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Abstract

Protective effect of resveratrol on sodium fluoride-induced oxidative stress, hepatotoxicity and neurotoxicity were studied in rats. A total of 28 Wistar albino male rats were used. Four study groups were randomly formed with seven animals in each. The groups were treated for 21days with distilled water (control group), with water containing 100ppm fluoride (fluoride group), with resveratrol (12.5mg/kg i.p., resveratrol group), or with 100ppm fluoride+12.5mg/kg resveratrol i.p. (fluoride+resveratrol group). At the end of the trial, blood samples were collected by cardiac puncture and tissue samples were taken simultaneously. The total antioxidant and oxidant status in plasma and tissues as well as plasma 8-hydroxydeoxyguanosine levels were measured. Histopathological analyses of rat liver and brain tissues were performed in all groups to identify any changes. In the fluoride group, the total oxidant levels increased in plasma, liver and brain and total antioxidant levels decreased, as did the plasma 8-hydroxy-deoxyguanosine levels. These changes were prevented by co-administration of resveratrol. In addition, fluoride-associated severe histopathological changes in brain and liver tissues were not observed in the fluoride+resveratrol group. Consequently, these data suggested that resveratrol had beneficial effects in alleviating fluoride-induced oxidative stress.

In the fluoride group, the total oxidant levels increased in plasma, liver and brain and total antioxidant levels decreased

Link: http://www.ncbi.nlm.nih.gov/pubmed/24857819

International Journal of Molecular Science
May 20, 2014

Genes and gene networks involved in sodium fluoride-elicited cell death accompanying endoplasmic reticulum stress in oral epithelial cells

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Abstract

Here, to understand the molecular mechanisms underlying cell death induced by sodium fluoride (NaF), we analyzed gene expression patterns in rat oral epithelial ROE2 cells exposed to NaF using global-scale microarrays and bioinformatics tools. A relatively high concentration of NaF (2 mM) induced cell death concomitant with decreases in mitochondrial membrane potential, chromatin condensation and caspase-3 activation. Using 980 probe sets, we identified 432 up-regulated and 548 down-regulated genes, that were differentially expressed by >2.5-fold in the cells treated with 2 mM of NaF and categorized them into 4 groups by K-means clustering. Ingenuity® pathway analysis revealed several gene networks from gene clusters. The gene networks Up-I and Up-II included many up-regulated genes that were mainly associated with the biological function of induction or prevention of cell death, respectively, such as Atf3, Ddit3 and Fos (for Up-I) and Atf4 and Hspa5 (for Up-II). Interestingly, knockdown of Ddit3 and Hspa5 significantly increased and decreased the number of viable cells, respectively. Moreover, several endoplasmic reticulum (ER) stress-related genes including, Ddit3, Atf4 and Hapa5, were observed in these gene networks. These findings will provide further insight into the molecular mechanisms of NaF-induced cell death accompanying ER stress in oral epithelial cells.

Here, to understand the molecular mechanisms underlying cell death induced by sodium fluoride

Link: http://www.ncbi.nlm.nih.gov/pubmed/24853129

Advances in Pharmacological Science
Mar 26, 2014

Effects of melatonin and epiphyseal proteins on fluoride-induced adverse changes in antioxidant status of heart, liver, and kidney of rats

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Abstract

Several experimental and clinical reports indicated the oxidative stress-mediated adverse changes in vital organs of human and animal in fluoride (F) toxicity. Therefore, the present study was undertaken to evaluate the therapeutic effect of buffalo (Bubalus bubalis) epiphyseal (pineal) proteins (BEP) and melatonin (MEL) against F-induced oxidative stress in heart, liver, and kidney of experimental adult female rats. To accomplish this experimental objective, twenty-four adult female Wistar rats (123-143 g body weights) were divided into four groups, namely, control, F, F + BEP, and F + MEL and were administered sodium fluoride (NaF, 150 ppm elemental F in drinking water), MEL (10 mg/kg BW, i.p.), and BEP (100 µg/kg BW, i.p.) for 28 days. There were significantly ($P < 0.05$) high levels of lipid peroxidation and catalase and low levels of reduced glutathione, superoxide dismutase, glutathione reductase, and glutathione peroxidase in cardiac, hepatic, and renal tissues of F-treated rats. Administration of BEP and MEL in F-treated rats, however, significantly ($P < 0.05$) attenuated these adverse changes in all the target components of antioxidant defense system of cardiac, hepatic, and renal tissues. The present data suggest that F can induce oxidative stress in liver, heart, and kidney of female rats which may be a mechanism in F toxicity and these adverse effects can be ameliorated by buffalo (Bubalus bubalis) epiphyseal proteins and melatonin by upregulation of antioxidant defense system of heart, liver, and kidney of rats.

The present data suggest that F can induce oxidative stress in liver, heart, and kidney of female rats which may be a mechanism in F toxicity

Link: http://www.ncbi.nlm.nih.gov/pubmed/24790596

Environment International
April 22, 2014

Assessing the risk of an excess fluoride intake among Swedish children in households with private wells—expanding static single-source methods to a probabilistic multi-exposure-pathway approach

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Abstract

It is often assumed that water consumption is the major route of exposure for fluoride and analysis of water fluoride content is the most common approach for ensuring that the daily intake is not too high. In the present study, the risk of excess intake was characterized for children in households with private wells in Kalmar County, Sweden, where the natural geology shows local enrichments in fluorine. By comparing water concentrations with the WHO drinking water guideline (1.5 mg/L), it was found that 24% of the ca. 4800 sampled wells had a concentration above this limit, hence providing a figure for the number of children in the households concerned assessed to be at risk using this straightforward approach. The risk of an excess intake could, alternatively, also be characterized based on a tolerable daily intake (in this case the US EPA RfD of 0.06 mg/kg-day). The exposure to be evaluated was calculated using a probabilistic approach, where the variability in all exposure factors was considered, again for the same study population. The proportion of children assessed to be at risk after exposure from drinking water now increased to 48%, and when the probabilistic model was adjusted to also include other possible exposure pathways; beverages and food, ingestion of toothpaste, oral soil intake and dust inhalation, the number increased to 77%. Firstly, these results show how the risk characterization is affected by the basis of comparison. In this example, both of the reference values used are widely acknowledged. Secondly, it illustrates how much of the total exposure may be overlooked when only focusing on one exposure pathway, and thirdly, it shows the importance of considering the variability in all relevant pathways.

The proportion of children assessed to be at risk after exposure from drinking water now increased to 48%, and when the probabilistic model was adjusted to also include other possible exposure pathways; beverages and food, ingestion of toothpaste, oral soil intake and dust inhalation, the number increased to 77%

Link: http://www.ncbi.nlm.nih.gov/pubmed/24747328

International Journal of Nanomedicine
April 2, 2014

Pharmacological and toxicological effects of co-exposure of human gingival fibroblasts to silver nanoparticles and sodium fluoride

Inkielewicz-Stepniak I, Santos-Martinez MJ, Medina C, Radomski MW

Abstract

Silver nanoparticles (AgNPs) and fluoride (F) are pharmacological agents widely used in oral medicine and dental practice due to their anti-microbial/anti-cavity properties. However, risks associated with the co-exposure of local cells and tissues to these xenobiotics are not clear. Therefore, we have evaluated the effects of AgNPs and F co-exposure on human gingival fibroblast cells.

Methodology

Human gingival fibroblast cells (CRL-2014) were exposed to AgNPs and/or F at different concentrations for up to 24 hours. Cellular uptake of AgNPs was examined by transmission electron microscopy. Downstream inflammatory effects and oxidative stress were measured by real-time quantitative polymerase chain reaction (PCR) and reactive oxygen species (ROS) generation. Cytotoxicity and apoptosis were measured by 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay and real-time quantitative PCR and flow cytometry, respectively. Finally, the involvement of mitogen-activated protein kinases (MAPK) was studied using Western blot.

Results

We found that AgNPs penetrated the cell membrane and localized inside the mitochondria. Co-incubation experiments resulted in increased oxidative stress, inflammation, and apoptosis. In addition, we found that co-exposure to both xenobiotics phosphorylated MAPK, particularly p42/44 MAPK.

Conclusion

A combined exposure of human fibroblasts to AgNPs and F results in increased cellular damage. Further studies are needed in order to evaluate pharmacological and potentially toxicological effects of AgNPs and F on oral health.

A combined exposure of human fibroblasts to silver nanoparticles (AgNPs) and fluoride (F) results in increased cellular damage

Link: http://www.ncbi.nlm.nih.gov/pubmed/24729703

Journal of Hazardous Materials
May 15, 2014

Sodium fluoride activates ERK and JNK via induction of oxidative stress to promote apoptosis and impairs ovarian function in rats

Geng Y, Qiu Y, Liu X, Chen X, Ding Y, Liu S, Zhao Y, Gao R, Wang Y, He J

Abstract

The toxicity of sodium fluoride (NaF) to female fertility is currently recognized; however, the mechanisms are unclear. Previously, we reported a reduction in successful pregnancy rates, ovarian atrophy and dysfunction following exposure to NaF. The purpose of this study was to elucidate the underlying molecular mechanisms. Female Sprague-Dawley rats (10 rats/group) received 100 or 200mg/L NaF in their drinking water for 6 months or were assigned to an untreated control group. Apoptotic indices and oxidative stress indicators in blood and ovarian tissue were analyzed following sacrifice. The results confirmed the NaF-induced ovarian apoptosis, with concomitant activation of oxidative stress. Further investigations in ovarian granular cells showed that exposure to NaF activated extracellular regulated protein kinase (ERK) and c-Jun NH2 kinase (JNK), disrupting the ERK and JNK signaling pathways, while p38 and PI3K remained unchanged. These data demonstrated that oxidative stress may play a key role in NaF-induced ovarian dysfunction by activating the apoptotic ERK and JNK signaling pathways.

The results confirmed the sodium fluoride (NaF)-induced ovarian apoptosis, with concomitant activation of oxidative stress

Link: http://www.ncbi.nlm.nih.gov/pubmed/24681588

Molecular Medicine Report
June 9, 2014

Autophagy may protect MC3T3-E1 cells from fluoride-induced apoptosis

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Abstract

Fluoride is an essential trace element for all mammalian species; however, excess fluoride intake is known to be toxic to cells in animals and humans. The toxicity of fluoride is mainly exerted via induction of apoptosis. Autophagy is induced by numerous cytotoxic stimuli; however, it is often unclear whether, under specific conditions, autophagy has a pro-survival or a pro-apoptotic role. To answer this critical question, the present study assessed autophagy and apoptosis simultaneously in single cells. It was demonstrated that fluoride was able to inhibit cell proliferation and induce apoptosis and autophagy, whereas autophagy appeared to be protective. Further analysis revealed that MAPK/JNK-dependent autophagy may be protective in fluoride-induced apoptosis. It is anticipated that the presented single-cell approach may be a powerful tool for gaining a quantitative understanding of the complex regulation of autophagy, its effect on cell fate and its association with other cellular pathways.

excess fluoride intake is known
to be toxic to cells in animals and humans

Link: http://www.ncbi.nlm.nih.gov/pubmed/24682525

Water Research
June 1, 2014

Performance of an optimized Zr-based nanoparticle-embedded PSF blend hollow fiber membrane in treatment of fluoride contaminated water

He J, Siah TS, Paul Chen J

Abstract

Consumption of water that has excessive fluoride can cause adverse health impacts on human beings. A Zr-based nanoparticle-embedded PSF blend hollow fiber membrane was successfully prepared and optimized for removal of fluoride from the aqueous solution. Both static and dynamic adsorption of fluoride on the membrane was investigated. It was showed that the membrane could effectively remove fluoride within a wide pH ranging from 3 to 10. At neutral pH, the adsorption equilibrium was reached within 24 h. The maximum adsorption capacity of the optimized membrane was 60.65 mg/g, much higher than many commercial adsorbents. The presence of NO3(-), SiO3(2-) or HA has insignificant effects on the fluoride removal. However, the removal was retarded as the concentration of HCO3(-) or PO4(3-) was increased. Furthermore, the membrane could remove fluoride efficiently through the continuous filtration, even in presence of natural organic matters. The spent membrane could be regenerated and then reused for the removal of fluoride with great efficiency. The adsorption history could be well described by an intraparticle diffusion model. The XPS analysis showed that the adsorption of fluoride was mainly associated with the ion-exchange between SO4(2-) and F(-) ions. Finally, the toxicity analysis revealed that the treated water was safe for human consumption.

Consumption of water that has excessive fluoride
can cause adverse health impacts on human beings

Link: http://www.ncbi.nlm.nih.gov/pubmed/24657326

Toxicology
April 6, 2014

Effect of water fluoridation on the development of medial vascular calcification in uremic rats

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Abstract

Public water fluoridation is a common policy for improving dental health. Fluoride replaces the hydroxyls of hydroxyapatite, thereby improving the strength of tooth enamel, but this process can also occur in other active calcifications. This paper studies the effects of water fluoridation during the course of vascular calcification in renal disease. The effect of fluoride was studied in vitro and in vivo. Rat aortic smooth muscle cells were calcified with 2mM Pi for 5 days. Fluoride concentrations of 5-10 μM--similar to those found in people who drink fluoridated water--partially prevented calcification, death, and osteogene expression in vitro. The anticalcifying mechanism was independent of cell activity, matrix Gla protein, and fetuin A expressions, and it exhibited an IC50 of 8.7 μM fluoride. In vivo, however, fluoridation of drinking water at 1.5mg/L (concentration recommended by the WHO) and 15 mg/L dramatically increased the incipient aortic calcification observed in rats with experimental chronic kidney disease (CKD, 5/6-nephrectomy), fed a Pi-rich fodder (1.2% Pi). Fluoride further declined the remaining renal function of the CKD animals, an effect that most likely overwhelmed the positive effect of fluoride on calcification in vitro. Ultrastructural analysis revealed that fluoride did not modify the Ca/P atomic ratio, but it was incorporated into the lattice of in vivo deposits. Fluoride also converted the crystallization pattern from plate to rode-like structures. In conclusion, while fluoride prevents calcification in vitro, the WHO's recommended concentrations in drinking water become nephrotoxic to CKD rats, thereby aggravating renal disease and making media vascular calcification significant.

In conclusion, while fluoride prevents calcification in vitro, the WHO's recommended concentrations in drinking water become nephrotoxic to CKD rats, thereby aggravating renal disease and making media vascular calcification significant

Link: http://www.ncbi.nlm.nih.gov/pubmed/24561004

Lancet Neurolology
March 13, 2014

Neurobehavioural effects of developmental toxicity

Grandjean P, Landrigan PJ

Abstract

Neurodevelopmental disabilities, including autism, attention-deficit hyperactivity disorder, dyslexia, and other cognitive impairments, affect millions of children worldwide, and some diagnoses seem to be increasing in frequency. Industrial chemicals that injure the developing brain are among the known causes for this rise in prevalence. In 2006, we did a systematic review and identified five industrial chemicals as developmental neurotoxicants: lead, methylmercury, polychlorinated biphenyls, arsenic, and toluene. Since 2006, epidemiological studies have documented six additional developmental neurotoxicants-manganese, fluoride, chlorpyrifos, dichlorodiphenyltrichloroethane, tetrachloroethylene, and the polybrominated diphenyl ethers. We postulate that even more neurotoxicants remain undiscovered. To control the pandemic of developmental neurotoxicity, we propose a global prevention strategy. Untested chemicals should not be presumed to be safe to brain development, and chemicals in existing use and all new chemicals must therefore be tested for developmental neurotoxicity. To coordinate these efforts and to accelerate translation of science into prevention, we propose the urgent formation of a new international clearinghouse.

Untested chemicals should not be presumed to be safe to brain development, and chemicals in existing use and all new chemicals must therefore be tested for developmental neurotoxicity

Link: http://www.ncbi.nlm.nih.gov/pubmed/24556010

Journal of Agricultural and Food Chemistry
March 12, 2014

Localization of fluoride and aluminum in subcellular fractions of tea leaves and roots

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Abstract

The tea plant is a fluoride (F) and aluminum (Al) hyperaccumulator. High concentrations of F and Al have always been found in tea leaves without symptoms of toxicity, which may be related to the special localization of F and Al in tea leaves. In this study, we for the first time determined the subcellular localization of F and Al in tea roots and leaves and provided evidence of the detoxification mechanisms of high concentrations of F and Al in tea plants. Results revealed that 52.3 and 71.8% of the total F accumulated in the soluble fraction of tea roots and leaves, and vacuoles contained 98.1% of the total F measured in the protoplasts of tea leaves. Cell walls contained 69.8 and 75.2% of the total Al detected in the tea roots and leaves, respectively, and 73.2% of Al sequestered in cell walls was immobilized by pectin and hemicellulose components. Meanwhile, 88.3% of the Al measured in protoplasts was stored in the vacuoles of tea leaves. Our results suggested that the subcellular distributions of F and Al in tea plants play two important roles in the detoxification of F and Al toxicities. First, most of the F and Al was sequestered in the vacuole fractions in tea leaves, which could reduce their toxicities to organelles. Second, Al can be immobilized in the pectin and hemicellulose components of cell walls, which could suppress the uptake of Al by tea roots.

The tea plant is a fluoride (F) and aluminum (Al) hyperaccumulator

Link: http://www.ncbi.nlm.nih.gov/pubmed/24548055

Mutation Research Genetic Toxicology and Environmental Mutagenesis
January 21, 2014

Arsenic and fluoride co-exposure affects the expression of apoptotic and inflammatory genes and proteins in mononuclear cells from children

Estrada-Capetillo BL, Ortiz-Pérez MD, Salgado-Bustamante M, Calderón-Aranda E, Rodríguez-Pinal CJ, Reynaga-Hernández E, Corral-Fernández NE, González-Amaro R, Portales-Pérez DP

Abstract

Humans may be exposed to arsenic (As) and fluoride (F) through water consumption. However, the interaction between these two elements and gene expression in apoptosis or inflammatory processes in children has not been thoroughly investigated. Herein, the expression of cIAP-1, XIAP, TNF-α, ENA-78, survivin, CD25, and CD40 was evaluated by RT-PCR. Additionally, the surface expression of CD25, CD40, and CD40L on peripheral blood mononuclear cells was analyzed by flow cytometry, and TNF-α was measured by Western blotting. This study examined 72 children aged 6-12 years who were chronically exposed to As (154.2μg/L) and F (5.3mg/L) in drinking water and in food cooked with the same water. The urine concentrations of As (6.9-122.4μg/L) were positively correlated with the urine concentrations of F (1.0-8.8mg/L) ($r(2)=0.413$, $p<0.0001$). The CD25 gene expression levels and urine concentrations of As and F were negatively correlated, though the CD40 expression levels were negatively correlated only with the As concentration. Age and height influenced the expression of cIAP-1, whereas XIAP expression was correlated only with age. Additionally, there was a lower percentage of CD25- and CD40-positive cells in the group of 6- to 8-year-old children exposed to the highest concentrations of both As and F when compared to the 9- to 12-year-old group (CD25: 0.7±0.8 vs. 1.1±0.9, $p<0.0014$; CD40: 16.0±7.0 vs. 21.8±5.8, $p<0.0003$). PHA-stimulated lymphocytes did not show any changes in the induction of CD25, CD69, or CD95. In summary, high concentrations of As and F alter the expression patterns of CD25 and CD40 at both the genetic and protein levels. These changes could decrease immune responses in children exposed to As and F.

These changes could decrease immune responses in children exposed to Arsenic and Fluoride

Link: http://www.ncbi.nlm.nih.gov/pubmed/24456662

Journal of Food Science and Technology
May 5, 2013

A multigrain protein enriched diet mitigates fluoride toxicity

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Abstract

Fluorosis is a major health problem in many parts of the world. The present work focuses on investigating the utility of nutrient and antioxidant rich grains- ragi, jowar, bajra, maize in formulation of basal, high carbohydrate low protein and low carbohydrate high protein diets in mitigating fluoride toxicity. Exposure to fluoride through drinking water not only significantly increased plasma glucose and lipid profiles, but also elevated both hepatic and renal lipid peroxidation, hepatic lipid profiles and G-6-Pase activity with a reduction in plasma HDL-C, hepatic glycogen content, hexokinase activity and antioxidant status. Even though basal and high carbohydrate diets did not significantly alter plasma glucose, lipid profiles in fluoride administered animals, protein enriched multigrain diet significantly decreased plasma glucose and lipid levels. However, the multigrain basal and high carbohydrate diets influenced the hepatic glycogen, lipid profiles, hexokinase and G-6-Pase activities, hepatic and renal lipid peroxidation and antioxidant status though not as significantly as that of multigrain diet enriched with protein. Thus the results of the present study indicate that both a multigrain diet rich in nutrients and antioxidants, and fortified with protein is useful in mitigating the fluoride toxicity.

Thus the results of the present study indicate that both a multigrain diet rich in nutrients and antioxidants, and fortified with protein is useful in mitigating the fluoride toxicity

Link: http://www.ncbi.nlm.nih.gov/pubmed/24425948

Romanian Journal of Morphology and Embryology
2013

Testicular histopathological changes following sodium fluoride administration in mice

Dimcevici Poesina N1, Bălălău C, Bârcă M, Ion I, Baconi D, Baston C, Băran Poesina V.

Abstract

It has been revealed that excessive fluoride intake on long-term is associated with toxic effects and can damage a variety of organs and tissues in the human body, including the male reproductive system. However, the molecular mechanisms of fluoride-induced male reproductive toxicity are not well understood. The study wants to get news concerning the effects of natrium fluoride on testicular tissues when this substance is administrated to a population of mice. The study was conducted on NMRI mice descending from the pregnant females treated with 0.25 mg and 0.5 mg natrium fluoride by daily gavage, from the beginning of pregnancy until the lactation is ceased. Then, the mice, males and females, were divided in six groups, three groups descending from the pregnant females treated with 0.5 mg natrium fluoride (Groups A, B and C) and three groups from the pregnant females with 0.25 mg natrium fluoride (Groups D, E and F). From the moment when the lactation is finished until the adulthood, the animals received the following treatments: homeopathic (a CH7 solution of natrium fluoride - Groups A and D), allopathic-homeopathic (0.25 mg‰ natrium fluoride administered like drinking water ad libitum and CH7 solution of natrium fluoride - Group E; 0.5 mg‰ natrium fluoride administered like drinking water ad libitum and CH7 solution of natrium fluoride - Group B), and allopathic administration of natrium fluoride (0.25 mg‰ natrium fluoride like drinking water ad libitum - Group F; 0.5 mg‰ natrium fluoride like drinking water ad libitum - Group C). When the males reached the adulthood, the administration of natrium fluoride was stopped and, by randomization, they where selected for euthanasia. The euthanasia was realized by cervical dislocation. The testes for the histopathological examination were preserved in a 10% formalin solution. The preparation of samples for optical microscopy was realized with Hematoxylin-Eosin staining. The results indicate that natrium fluoride administered in different doses, even at homeopathic dose or at allopathic-homeopathic dose, determined vacuolar dystrophy of epididymal epithelial cells, vacuolar dystrophy of linear seminal cells and necrosis.

The results indicate that natrium fluoride administered in different doses, even at homeopathic dose or at allopathic-homeopathic dose, determined vacuolar dystrophy of epididymal epithelial cells, vacuolar dystrophy of linear seminal cells and necrosis

Link: http://www.ncbi.nlm.nih.gov/pubmed/24398997
Link to full paper: http://www.rjme.ro/RJME/resources/files/54041310191024.pdf

Scientific World Journal
Nov 20, 2013

Drinking water fluoride levels for a city in northern Mexico (Durango) determined using a direct electrochemical method and their potential effects on oral health

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Abstract

Fluoride is ingested primarily through consuming drinking water. When drinking water contains fluoride concentrations>0.7 parts per million (ppm), consuming such water can be toxic to the human body; this toxicity is called "fluorosis." Therefore, it is critical to determine the fluoride concentrations in drinking water. The objective of this study was to determine the fluoride concentration in the drinking water of the city of Durango. The wells that supply the drinking water distribution system for the city of Durango were studied. One hundred eighty-nine (189) water samples were analyzed, and the fluoride concentration in each sample was quantified as established by the law NMX-AA-077-SCFI-2001. The fluoride concentrations in such samples varied between 2.22 and 7.23 ppm with a 4.313±1.318 ppm mean concentration. The highest values were observed in the northern area of the city, with a 5.001±2.669 ppm mean value. The samples produced values that exceeded the national standard for fluoride in drinking water. Chronic exposure to fluoride at such concentrations produces harmful health effects, the first sign of which is dental fluorosis. Therefore, it is essential that the government authorities implement water defluoridation programs and take preventative measures to reduce the ingestion of this toxic halogen.

Therefore, it is essential that the government authorities implement water defluoridation programs and take preventative measures to reduce the ingestion of this toxic halogen

Link: http://www.ncbi.nlm.nih.gov/pubmed/24348140

Environmental Toxicology and Chemistry
January 3, 2014

Comparison of the toxicity of fluoridation compounds in the nematode Caenorhabditis elegans

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Abstract

Fluorides are commonly added to drinking water in the United States to decrease the incidence of dental caries. Silicofluorides, such as sodium hexafluorosilicate (Na2 SiF6) and fluorosilicic acid (H2 SiF6), are mainly used for fluoridation, although fluoride salts such as sodium fluoride (NaF) are also used. Interestingly, only the toxicity of NaF has been examined and not that of the more often used silicofluorides. In the present study, the toxicities of NaF, Na2 SiF6 , and H2 SiF6 were compared. The toxicity of these fluorides on the growth, feeding, and reproduction in the alternative toxicological testing organism Caenorhabditis elegans was examined. Exposure to these compounds produced classic concentration-response toxicity profiles. Although the effects of the fluoride compounds varied among the 3 biological endpoints, no differences were found between the 3 compounds, relative to the fluoride ion concentration, in any of the assays. This suggests that silicofluorides have similar toxicity to NaF.

This suggests that silicofluorides have similar toxicity to NaF (sodium fluoride)

Link: http://www.ncbi.nlm.nih.gov/pubmed/24105802

Mediators of Inflammation
August 29, 2013

JNK and NADPH oxidase involved in fluoride-induced oxidative stress in BV-2 microglia cells

Yan L1, Liu S, Wang C, Wang F, Song Y, Yan N, Xi S, Liu Z, Sun G.

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Abstract

Excessive fluoride may cause central nervous system (CNS) dysfunction, and oxidative stress is a recognized mode of action of fluoride toxicity. In CNS, activated microglial cells can release more reactive oxygen species (ROS), and NADPH oxidase (NOX) is the major enzyme for the production of extracellular superoxide in microglia. ROS have been characterized as an important secondary messenger and modulator for various mammalian intracellular signaling pathways, including the MAPK pathways. In this study we examined ROS production and TNF- α , IL-1 β inflammatory cytokines releasing, and the expression of MAPKs in BV-2 microglia cells treated with fluoride. We found that fluoride increased JNK phosphorylation level of BV-2 cells and pretreatment with JNK inhibitor SP600125 markedly reduced the levels of intracellular O□(·-) and NO. NOX inhibitor apocynin and iNOS inhibitor SMT dramatically decreased NaF-induced ROS and NO generations, respectively. Antioxidant melatonin (MEL) resulted in a reduction in JNK phosphorylation in fluoride-stimulated BV-2 microglia. The results confirmed that NOX and iNOS played an important role in fluoride inducing oxidative stress and NO production and JNK took part in the oxidative stress induced by fluoride and meanwhile also could be activated by ROS in fluoride-treated BV-2 cells.

Excessive fluoride may cause central nervous system (CNS) dysfunction, and oxidative stress is a recognized mode of action of fluoride toxicity

Link: http://www.ncbi.nlm.nih.gov/pubmed/24072958

The Journal of the Association of Physicians in India
July 2014

Early diagnosis and complete recovery from fluorosis through practice of interventions

Susheela AK, Mondal NK, Tripathi N, Gupta R.

Abstract

Objectives: The objective of this communication is to disseminate scientific and technical information for early diagnosis of Fluorosis; recent developments in care and management of patients of Fluorosis.

Materials and Methodology: Body fluids collected from patients suspected of Fluorosis referred by hospitals, samples of drinking water used by them are the materials that have been investigated. Fluoride level in body fluids and water samples are tested by the ion selective electrode (ISE) potentiometry. Forearm X-ray radiograph is taken to assess interosseous membrane calcification. Upon diagnosis of the disease, two corrective measures, namely diet editing and diet counselling are introduced for practice in daily life. In the former, all sources of fluoride ingestion and use are withdrawn whereas in the latter, the patient is encouraged to consume a diet rich in essential nutrients, antioxidants and micronutrients through fruits, vegetables and dairy products. The patients are monitored at intervals to assess fluoride in body fluids. Reduction in fluoride levels has a direct relationship with disappearance of health complaints and subsequent recovery.

Results: Eight case studies (5 male + 3 female) are described. Patients'complaints are gastrointestinal discomfort, polyuria, polydipsia, muscle weakness, fatigue and joint pain. Body fluids may have high fluoride with normal or high fluoride level in drinking water. The main source(s) of fluoride entry identified are (i) consuming fluoride contaminated food/snacks/beverages laced with black rock salt; (ii) drinking of untreated ground water; (iii) using fluoridated toothpaste. The duration of recovery varies from patient to patient depending upon their body physiology and the seriousness with which the interventions were practiced. Recurrence of the disease may occur in some patients due to change in life-style, not practicing interventions, entry of fluoride inadvertently.

Conclusion: This communication provides an overview of Fluorosis, its occurrence, manifestations, diagnostic tests, results, interventions practiced, monitoring and recovery from the disease.

The main source(s) of fluoride entry identified are (i) consuming fluoride contaminated food/snacks/beverages laced with black rock salt; (ii) drinking of untreated ground water; (iii) using fluoridated toothpaste

Link: http://www.ncbi.nlm.nih.gov/pubmed/25672028

Scientific World Journal
February 19, 2015

Association between Urine Fluoride and Dental Fluorosis as a Toxicity Factor in a Rural Community in the State of San Luis Potosi

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Abstract

Objective. The aim of this study is to investigate urine fluoride concentration as a toxicity factor in a rural community in the state of San Luis Potosi, Mexico. Materials and Methods. A sample of 111 children exposed to high concentrations of fluoride in drinking water (4.13 mg/L) was evaluated. Fluoride exposure was determined by measuring urine fluoride concentration using the potentiometric method with an ion selective electrode. The diagnosis of dental fluorosis was performed by clinical examination, and the severity of damage was determined using Dean's index and the Thylstrup-Fejerskov (TF) index. Results. The range of exposure in the study population, evaluated through the fluoride content in urine, was 1.1 to 5.9 mg/L, with a mean of 3.14 ± 1.09 mg/L. Dental fluorosis was present in all subjects, of which 95% had severe cases. Higher urine fluoride levels and greater degrees of severity occurred in older children. Conclusions. The results show that dental fluorosis was determined by the presence of fluoride exposure finding a high positive correlation between the severity of fluorosis and urine fluoride concentration and the years of exposure suggested a cumulative effect.

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Link: http://www.ncbi.nlm.nih.gov/pubmed/25789336

Environmental Science and Pollution Research International
Mar 20, 2015

The impact of aluminum, fluoride, and aluminum-fluoride complexes in drinking water on chronic kidney disease

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Abstract

It is suspected that drinking water containing fluoride and aluminum results in negative health effects especially on brain, liver, and kidney. In this investigation, the effect of F, Al, and AlFx complex on chronic kidney disease (CKD) was investigated. Mice were treated either with WHO recommended or slightly higher F and Al levels in drinking water. Treatment solutions contained 0.05-10.0 mg/L of F, 0.08-10.0 mg/L of Al, or 0.07-15 mg/L of AlFx, and the treatment period was 42 weeks. Blood urea level and creatinine levels were investigated as a measure of malfunction of kidneys. Histopathological evaluations of kidney tissues were carried out to assess the extent of damage that F, Al, and AlFx complex could cause. It was demonstrated that the treated drinking water containing F and Al with par with WHO or moderately above the WHO levels or AlFx in low level (0.07-15 mg/L) does not lead to CKD in mice.

Link: http://www.ncbi.nlm.nih.gov/pubmed/25787218

*Note: I've included these two slightly conflicting but very different studies for a reason. In the study at left a fluoride content in drinking water of 4.13mg/L is considered a "*high concentration*" of fluoride in drinking water and the study results indicate that, "*Dental fluorosis was present in all subjects, of which 95% had severe cases*." In the study at right, mice were treated with World Health Organization recommended fluoride levels "*or slightly higher F*" in their drinking water. The study at right further states that, "*Treatment solutions contained 0.05-10.0 mg/L of F...* " The study at right uses statistically similar fluoride concentrations as the study at left. The study at right finds no correlation between fluoride content in mice and chronic kidney disease while the study at left using similar fluoride concentrations finds that "*95% [of children] had severe cases*" of dental fluorosis. These two studies taken together show the significant difficulty of determining causation in chemically attacked individuals where mice or other animals are substituted for humans. A concentration of 4.13mg/L found in the study at left cetainly falls within the range used—0.05 to 10.0mg/L—in the study at right. Of course the study at right didn't check the mice for dental fluorosis and naturally, no one asked the mice how they felt.

The Journal of Clinical Pediatric Dentistry
Summer 2014

Dental fluorosis: concentration of fluoride in drinking water and consumption of bottled beverages in school children

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Abstract

Objective: The purpose of the study was to identify dental fluorosis prevalence and to analyze its association with tap water fluoride concentration and beverage consumption in school children from the city of Oaxaca, who were receiving fluoridated salt.

Study Design: A cross-sectional study was performed on elementary public school children. Dean's Index was applied to assess dental fluorosis. The parents of the children who were studied completed a questionnaire about socio-demographic characteristics and type of beverages consumed by their children. A total of 917 school children participated in this study.

Results: Dental fluorosis prevalence was 80.8%. The most frequent fluorosis category was very mild (41.0%), and 16.4% of the children were in the mild category. The mean water fluoride concentration was 0.43 ppm (±0.12). No association was detected between tap water fluoride concentration and fluorosis severity. The multinomial regression model showed an association among the mild fluorosis category and age (OR = 1.25, [95% CI 1.04, 1.50]) and better socio-economic status (OR = 1.78, [95% CI 1.21, 2.60]), controlling for fluoride concentration in water. Moderate and severe fluorosis were associated with soft drink consumption (OR = 2.26, [95% IC 1.01, 5.09]), controlling for age, socio-economic status, and water fluoride concentration.

Conclusions: The prevalence of fluorosis was high. Mild fluorosis was associated with higher socio-economic status, while higher fluorosis severity was associated with soft drink consumption.

higher fluorosis severity was associated with soft drink consumption

Link: http://www.ncbi.nlm.nih.gov/pubmed/25571686

Environmental Science and Technology
January 2, 2015

Critical Review and Rethinking of USEPA Secondary Standards for Maintaining Organoleptic Quality of Drinking Water

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Abstract

Consumers assess their tap water primarily by its taste, odor, and appearance. Starting in 1979, USEPA promulgated Secondary Maximum Contaminant Levels (SMCLs) as guidance for contaminants with organoleptic effects and also to maintain consumers' confidence in tap water. This review assesses the basis for the 15 SMCLs (aluminum, chloride, color, copper, corrosivity, fluoride, foaming agents, iron, manganese, odor, pH, silver, sulfate, total dissolved solids, zinc) and summarizes advances in scientific knowledge since their promulgation. SMCLs for aluminum, color, pH, silver, sulfate, total dissolved solids, and zinc are appropriate at current values and remain consistent with sensory science literature. Recent advances in sensory and health sciences indicate that SMCLs for chloride, copper, fluoride, iron, and manganese are too high to minimize organoleptic effects. The SMCLs for corrosivity and foaming agents may be outdated. The SMCL for odor requires rethinking as the test does not correlate with consumer complaints. Since current stresses on source and treated waters include chemical spills, algal blooms, and increased salinization, organoleptic episodes that negatively impact consumer confidence and perception of tap water still occur and may increase. Thus, adherence to SMCLs can help maintain production of palatable water along with consumers' confidence in their water providers.

Recent advances in sensory and health sciences indicate that SMCLs [Secondary Maximum Contaminant Levels] for ... fluoride are too high to minimize organoleptic [involving the use of the sense organs] effects

Link: http://www.ncbi.nlm.nih.gov/pubmed/25517292

The Journal of Investigative and Clinical Dentistry

February 6, 2015

Dental fluorosis in the Blue Mountains and Hawkesbury, New South Wales, Australia: Policy Implications

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Author information

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Abstract

AIm: The aim of the present study was to determine whether the adjustment of the fluoride concentration to 1 ppm in the drinking water supplied to the Blue Mountains, New South Wales, Australia in 1993 was associated with fluorosis incidence.

Methodology: In 2003, children attending schools in the Blue Mountains and a control region (fluoridated in 1967) that had been randomly selected at baseline in 1992 were examined for dental fluorosis (maxillary central incisors only) using Dean's index. A fluoride history for each child was obtained by questionnaire. Associations between fluorosis and 58 potential explanatory variables were explored.

Results: The response rate was 63%. A total of 1138 children aged from 7 to 11 years with erupted permanent central incisors were examined for dental fluorosis. Fluorosis prevalence was the same in both regions. The Community Index of Dental Fluorosis values were slightly different, but were both above 0.6, indicative of public health concern.

Conclusions: For the group as a whole, we concluded that: (a) fluorosis prevalence (0.39) in both regions was similar; and (b) the higher-than-expected prevalence and severity of fluorosis was due mainly to two factors: (a) the higher-than-optimal fluoride level in drinking water; and (b) swallowing of fluoride toothpaste in early childhood.

For the group as a whole, we concluded that:
(a) fluorosis prevalence (0.39) in both regions was similar; and
(b) the higher-than-expected prevalence and severity of fluorosis was due mainly to two factors: (a) the higher-than-optimal fluoride level in drinking water; and (b) swallowing of fluoride toothpaste in early childhood

Link: http://www.ncbi.nlm.nih.gov/pubmed/25511082

Neurotoxicology and Teratology • January-February, 2015

Association of lifetime exposure to fluoride and cognitive functions in Chinese children: a pilot study

Choi AL1, Zhang Y2, Sun G3, Bellinger DC4, Wang K5, Yang XJ6, Li JS6, Zheng Q3, Fu Y7, Grandjean P8

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Abstract

Background: A systematic review and meta-analysis of published studies on developmental fluoride neurotoxicity support the hypothesis that exposure to elevated concentrations of fluoride in water is neurotoxic during development.

Methods: We carried out a pilot study of 51 first-grade children in southern Sichuan, China, using the fluoride concentration in morning urine after an exposure-free night; fluoride in well-water source; and dental fluorosis status as indices of past fluoride exposure. We administered a battery of age-appropriate, relatively culture-independent tests that reflect different functional domains: the Wide Range Assessment of Memory and Learning (WRAML), Wechsler Intelligence Scale for Children-Revised (WISC-IV) digit span and block design; finger tapping and grooved pegboard. Confounder-adjusted associations between exposure indicators and test scores were assessed using multiple regression models.

Results: Dental fluorosis score was the exposure indicator that had the strongest association with the outcome deficits, and the WISC-IV digit span subtest appeared to be the most sensitive outcome, where moderate and severe fluorosis was associated with a digit span total score difference of -4.28 (95% CI -8.22, -0.33) and backward score with -2.13 (95% CI -4.24, -0.02).

Conclusions: This pilot study in a community with stable lifetime fluoride exposures supports the notion that fluoride in drinking water may produce developmental neurotoxicity, and that the dose-dependence underlying this relationship needs to be characterized in detail.

in a community with stable lifetime fluoride exposures supports the notion that fluoride in drinking water may produce developmental neurotoxicity

Link: http://www.ncbi.nlm.nih.gov/pubmed/25446012

Indian Pediatrics
November 2014

Child fluorosis in Chhattisgarh, India: a community-based survey

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Abstract

Objective: To assess the prevalence and type of fluorosis among children from randomly selected villages of Chhattisgarh, and its relationship with fluoride levels in drinking water.

Methodology: A community based door-to-door survey was conducted in the sampled villages of seven districts of Chhattisgarh state during the year 2013-14. The field case definitions were used for labelling types of fluorosis. The fluoride concentration in drinking water was estimated by ion selective electrode method.

Results: The prevalence of fluorosis ranged between 12 to 44% in children of surveyed districts. The fluoride levels in drinking water of selected villages were in the range of 0.1-9.0 ppm.

Conclusions: Dental and skeletal fluorosis is endemic among children in the surveyed districts of Chhattisgarh State, and is related to drinking water with fluoride content of =1.5 ppm.

Dental and skeletal fluorosis is endemic among children
in the surveyed districts of Chhattisgarh State, and is related to drinking
water with fluoride content of =1.5 ppm
(the amount in US tap water)

Link: http://www.ncbi.nlm.nih.gov/pubmed/25432221

Environmental Science and Pollution Research International
November 19, 2014

A study to investigate fluoride contamination and fluoride exposure dose assessment in lateritic zones of West Bengal, India

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Abstract

To assess the status of severity of fluoride contamination in lateritic Bankura and Purulia districts of West Bengal, concentrations of fluoride in different water sources and agricultural field soils were investigated. The fluoride content (mg/l) was observed to differ with aquifer depths: 0.19-0.47 in dug wells, 0.01-0.17 in shallow tube wells, and 0.07-1.6 in deep tube wells. Fluoride within the World Health Organization (WHO) prescribed range (1.0-1.5 mg/l) was estimated only in ~17 % of the total collected water samples while ~67 % showed <0.7 mg/l fluoride and thus may impede in the production and maintenance of healthy teeth and bones of the residents, especially children. Fluoride in water was found to be significantly correlated (r=0.63) with pH. The exposure dose of fluoride (mg/kg/day) from drinking water in infants, children, and adults was estimated in the ranges 0.02-0.53, 0.01-0.24, and 0.01-0.14, respectively against the standard value of 0.05. A clear risk of dental fluorosis is apparent in infants and children of the study area. The fluoride in soil (55-399 mg/kg) was detected to be significantly correlated with the fluoride content in deep tube wells and soil pH (r=0.56 and 0.71, respectively). The relationships of soil fluoride with total hardness and that with phosphate were not significant. There is a high possibility of bioaccumulation of fluoride from contaminated soil and water of the study area to cultivated crops. This will enhance the quantity of fluoride intake into human food chain in addition to drinking water pathway.

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in addition to drinking water pathway

Link: http://www.ncbi.nlm.nih.gov/pubmed/25408071

The Journal of Physiology and Biochemistry
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Sodium fluoride induces apoptosis in the kidney of rats through caspase-mediated pathways and DNA damage

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Abstract

Long-term excessive sodium fluoride (NaF) intake can cause many bone diseases and nonskeletal fluorosis. The kidneys are the primary organs involved in the excretion and retention of NaF. The objective of the present study was to determine the effects of NaF treatment on renal cell apoptosis, DNA damage, and the protein expression levels of cytosolic cytochrome C (Cyt C) and cleaved caspases 9, 8, and 3 in vivo. Male Sprague-Dawley rats were divided randomly into four groups (control, low fluoride, medium fluoride, and high fluoride) and administered 0, 50, 100, and 200 mg/L of NaF, respectively, via drinking water for 120 days. Histopathological changes in the kidneys were visualized using hematoxylin and eosin staining. Renal cell apoptosis was examined using flow cytometry, and renal cell DNA damage was detected using the comet assay. Cytosolic Cyt C and cleaved caspases 9, 8, and 3 protein expression levels were visualized using immunohistochemistry and Western blotting. The results showed that NaF treatment increased apoptosis and DNA damage. In addition, NaF treatment increased the protein expression levels of cytosolic Cyt C and cleaved caspases 9, 8, and 3. These results indicated that NaF induces apoptosis in the kidney of rats through caspase-mediated pathway, and DNA damage may be involved in this process.

These results indicated that NaF [sodium fluoride] induces apoptosis in the kidney of rats through caspase-mediated pathway, and DNA damage may be involved in this process

Link: http://www.ncbi.nlm.nih.gov/pubmed/25158646

International Journal of Occupational and Environmental Health
April-June 2014

A new perspective on metals and other contaminants in fluoridation chemicals

Mullenix PJ.

Abstract

Background: Fluoride additives contain metal contaminants that must be diluted to meet drinking water regulations. However, each raw additive batch supplied to water facilities does not come labeled with concentrations per contaminant. This omission distorts exposure profiles and the risks associated with accidents and routine use.

Objectives: This study provides an independent determination of the metal content of raw fluoride products.

Methodology: Metal concentrations were analyzed in three hydrofluorosilicic acid (HFS) and four sodium fluoride (NaF) samples using inductively coupled plasma-atomic emission spectrometry. Arsenic levels were confirmed using graphite furnace atomic absorption analysis.

Results: Results show that metal content varies with batch, and all HFS samples contained arsenic (4·9-56·0 ppm) or arsenic in addition to lead (10·3 ppm). Two NaF samples contained barium (13·3-18·0 ppm) instead. All HFS (212-415 ppm) and NaF (3312-3630 ppm) additives contained a surprising amount of aluminum.

Conclusions: Such contaminant content creates a regulatory blind spot that jeopardizes any safe use of fluoride additives.

Fluoride additives contain metal contaminants ... each raw additive batch supplied to water facilities does not come labeled with concentrations per contaminant ... This omission distorts exposure ... associated with ... routine use

Link: http://www.ncbi.nlm.nih.gov/pubmed/24999851

The Journal of Evidence-Based Dental Practice
June 2014

Focus on fluorides: update on the use of fluoride for the prevention of dental caries

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Abstract

Background: Fluoride is delivered to the teeth systemically or topically to aid in the prevention of dental caries. Systemic fluoride from ingested sources is in blood serum and can be deposited only in teeth that are forming in children. Topical fluoride is from sources such as community water, processed foods, beverages, toothpastes, mouthrinses, gels, foams, and varnishes. The United States Centers for Disease Control and Prevention (CDC) and the American Dental Association (ADA) have proposed changes in their long standing recommendations for the amount of fluoride in community drinking water in response to concerns about an increasing incidence of dental fluorosis in children. Current research is focused on the development of strategies to improve fluoride efficacy. The purpose of this update is to inform the reader about new research and policies related to the use of fluoride for the prevention of dental caries.

Methodology: Reviews of the current research and recent evidence based systematic reviews on the topics of fluoride are presented. Topics discussed include: updates on community water fluoridation research and policies; available fluoride in dentifrices; fluoride varnish compositions, use, and recommendations; and other fluoride containing dental products. This update provides insights into current research and discusses proposed policy changes for the use of fluoride for the prevention of dental caries.

Conclusions: The dental profession is adjusting their recommendations for fluoride use based on current observations of the halo effect and subsequent outcomes. The research community is focused on improving the efficacy of fluoride therapies thus reducing dental caries and lowering the amount of fluoride required for efficacy.

The United States Centers for Disease Control and Prevention (CDC) and the American Dental Association (ADA) have proposed changes in their long standing recommendations for the amount of fluoride in community drinking water in response to concerns about an increasing incidence of dental fluorosis in children

Link: http://www.ncbi.nlm.nih.gov/pubmed/24929594

Physiology & Behavior
January 30, 2014

Fluoride exposure during development affects both cognition and emotion in mice

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Abstract

Previous studies have suggested that sodium fluoride (NaF) may have adverse effects on neurodevelopment. In the present study, we evaluated developmental neurotoxicity by assessing in cognitive function and emotional behavior in BalB/C mice treated with NaF. Mice were weaned at 4weeks, and water or different NaF concentrations (2, 5, or 10mg/L in drinking water) were provided for 4weeks. We found that exploration preference in the novel object recognition test was significantly altered in mice treated with 5 and 10mg/L NaF compared with the water-treated control animals. Furthermore, mice treated with 5 and 10mg/L NaF showed significantly longer escape latencies, less time in the target quadrant, and fewer platform-crossing numbers in the Morris water maze compared to those in the control group. In addition, mice treated with 10mg/L NaF spent a lower percentage of time in the open arms in the elevated-plus maze, while no significant changes were noted in the open and close arm entries or the total arm entries. We also found that the cumulative immobility time in the tail suspension test was longer in mice treated with 5 and 10mg/L NaF compared to the control group. Only 10mg/L NaF-treated mice showed longer immobility time compared with the control group. Collectively, our data indicate that developmental exposure to NaF induces cognitive deficits and anxiety-depression-like behaviors in mice.

Collectively, our data indicate that developmental exposure to NaF [sodium fluoride] induces cognitive deficits and anxiety-depression-like behaviors in mice

Link: http://www.ncbi.nlm.nih.gov/pubmed/24184405

Toxicology Letters
November 25, 2013

A brief review on experimental fluorosis

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Abstract

Fluoride (F) is a naturally occurring contaminant in the water. F is essential for normal maintenance of teeth and bones. However, prolonged exposure to high concentration of F is found to be deleterious to teeth, bones and other organs. Besides drinking water, F can enter the body through food, dental products, drugs and industrial emission. People living in areas where F contamination is much higher than the expected level, are found to suffer from not only teeth and bone problem but also other systems, including brain and its functions. Since animals respond to the toxic effects of F like human beings, the deleterious effects of F have been produced experimentally in animals in order to determine the mechanism involved in the action of F. The reports indicating the chronic harmful effects of F in teeth, bones, heart, liver, kidneys, gastrointestinal tract, lungs, brain, blood, hormones and biochemical parameters of experimental animals and in in vitro studies have been reviewed in this article. The neurotoxic action of F that produces chiefly learning and memory impairment has also been included. The review also points out the harmful effects of F on reproduction, its teratogenic action and in inducing premature ageing. Finally, the reports indicating a reversal of certain toxicities of F in experimental animals after withdrawal of its exposure has been included.

F [sodium fluoride] can enter the body through
food, dental products, drugs and industrial emission

Link: http://www.ncbi.nlm.nih.gov/pubmed/24050947

European Journal of Oral Sciences
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Total fluoride intake and excretion in children up to 4 years of age living in fluoridated and non-fluoridated areas

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Abstract

Fractional fluoride retention is important during the early years of life when considering the risk of development of dental fluorosis. This study aimed to measure fractional fluoride retention in young children. The objectives were to investigate the relationships between fractional fluoride retention and total daily fluoride intake, age, and body mass index (BMI). Twenty-nine healthy children, up to 4 yr of age, participated; 14 lived in a fluoridated area (0.64 µg ml(-1) of fluoride in drinking water) and 15 lived in a non-fluoridated area (0.04 µg ml(-1) of fluoride in drinking water). The total daily fluoride intake of each child was calculated from the daily dietary fluoride intake and toothpaste ingestion (if fluoride toothpaste was used). Total daily fluoride excretion was measured by collecting voided urine and faeces over a 24-h period, and fractional fluoride retention was calculated by dividing the amount of fluoride retained in the body (total daily fluoride intake minus total daily fluoride excretion) by the total daily fluoride intake. Nine children were excluded from data analysis because of suspected invalid samples. Mean (range) fractional fluoride retention for the remaining 20 children was 0.61 (0.06-0.98). There were no statistically significant correlations between fractional fluoride retention and either age or BMI. However, fractional fluoride retention was correlated with total daily fluoride intake: fractional fluoride retention = 1 - exp (-C × total daily fluoride intake), where C = 28.75 (95% CI = 19.75-37.75). The wide variation in fluoride retention in young children could have important implications when recommendations for fluoride use are being considered.

The wide variation in fluoride retention in young children
could have important implications when recommendations
for fluoride use are being considered

Link: http://www.ncbi.nlm.nih.gov/pubmed/24028594

Toxicology Mechanisms and Methods
January 24, 2014

Effect of sodium fluoride on neuroimmunological parameters, oxidative stress and antioxidative defenses

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Abstract

Aims: This study was designed to evaluate the effect of sodium fluoride (NaF) in inducing neuroimmunological, oxidative and antioxidative damage.

Methodology: Twenty-four male Wistar rats broadly grouped into four groups containing six rats in each were fed with drinking water containing 20 ppm, 60 ppm, 100 ppm and 0.8 ppm (control) NaF. After 90 days, rats were sacrificed to assess the level of fluoride content and various neurotransmitters in brain. The levels of CD4, natural killer (NK) cells and IgG1 were assessed in blood and spleen. In addition, lipid peroxidation coupled with the levels of various antioxidative enzymes was also recorded.

Results: Increase in the NaF concentration resulted in increased fluoride deposition in brain tissue. This increased fluoride content led to increased levels of certain neurotransmitters such as epinephrine, histamine, serotonin and glutamate and decreased levels of norepinephrine, acetylcholine and dopamine in a dose-dependent manner. NaF exposure led to the decrease in the levels of CD4, NK cells and IgG1 coupled with marked increase in lipid peroxidation and impairment of the antioxidative defense system.

Conclusion: The result of the study emphasizes the toxic role of high NaF doses on the neurological and immunological functions.

The result of the study emphasizes the toxic role of high NaF [sodium fluoride] doses on the neurological and immunological functions

Link: http://www.ncbi.nlm.nih.gov/pubmed/24024668

Journal of Dental Research, Dental Clinics and Dental Prospects
Winter 2013

Fluoride concentration of drinking waters and prevalence of fluorosis in iran: a systematic review

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Abstract

Background and aims: The aim of the present study was to systematically review fluoride concentration of drinking waters and prevalence of fluorosis in Iran through systematically evaluating results of studies conducted in this regard.

Materials and methods: In this systematic review study, the required data was collected using keywords including drinking water fluoride, fluoride concentration, Fluorosis, dent*, Iran*, and their Persian equivalents through PubMed, ScienceDirect, IranMedex, SID, MEDLIB, and Magiran databases. Out of 617 articles, 29 articles were finally considered after excluding the remaining articles which were not related to the study objectives. Following precise studying and extraction, the relevant data were summarized in extraction tables and analyzed manually. Excel 2007 software was used to draw diagrams.

Results: 4434 samples of surface, ground, and tap water resources collected within 236 months during all seasons in 17 provinces of Iran were used in 29 articles determining fluoride concentrations of drinking water. Average fluoride concentration was estimated to be 0.43 ± 0.17 ppm with zero and 3.06 as minimal and maximal values. The least concentration was seen in tap water. Fluoride concentration of only three provinces was in accordance with the global standard. According to estimations, prevalence of fluorosis was 61% with only 1% as severe fluorosis.

Conclusion: Despite lower than standard concentrations of fluoride in drinking water, a relatively high level of fluorosis was seen in Iran.

Despite lower than standard concentrations of fluoride in drinking water, a relatively high level of fluorosis was seen in Iran

Link: http://www.ncbi.nlm.nih.gov/pubmed/23486733

The Journal of Dental Research
April 2013

Effects of fluoridated drinking water on dental caries in Australian adults

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Abstract

Systematic reviews produce conflicting conclusions regarding dental caries-preventive effects of water fluoridation in adults. The authors investigated the relationship using data from the nationally representative 2004-2006 Australian National Survey of Adult Oral Health. Effects were compared between the pre-fluoridation cohort born before 1960 (n = 2,270) and the cohort born between 1960 and 1990 (n = 1,509), when widespread implementation of fluoridation increased population coverage from < 1% to 67%. Residential history questionnaires determined the percentage of each person's lifetime exposed to fluoridated water. Examiners recorded decayed, missing, and filled teeth (DMF-Teeth) and decayed and filled tooth surfaces (DF-Surfaces). Socio-demographic and preventive dental behaviors were included in multivariable least-squares regression models adjusted for potential confounding. In fully adjusted models, > 75% of lifetime exposure to fluoridation relative to < 25% of lifetime exposure was associated with 11% and 10% fewer DMF-Teeth in the pre-1960 ($p < .0001$) and 1960-1990 cohorts ($p = .018$), respectively. Corresponding reductions in DF-Surfaces were 30% ($p < .001$) and 21% ($p < .001$). Findings for intermediate fluoridation exposure suggested a dose-response relationship. Results were consistent in sensitivity analyses accounting for missing data. In this nationally representative sample of Australian adults, caries-preventive effects of water fluoridation were at least as great in adults born before widespread implementation of fluoridation as after widespread implementation of fluoridation.

In this nationally representative sample of Australian adults, caries-preventive effects of water fluoridation were at least as great in adults born before widespread implementation of fluoridation as after widespread implementation of fluoridation

Link: http://www.ncbi.nlm.nih.gov/pubmed/23456704

Mutation Research
February 18, 2013

Evaluation of multi-endpoint assay to detect genotoxicity and oxidative stress in mice exposed to sodium fluoride

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Author information

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Abstract

Fluoride compounds are naturally present in soil, water and food. The objective of this study was to investigate the genotoxic and oxidative damage induced by chronic fluoride exposure on mammalian cells in vivo. For this purpose, the genotoxic potential was investigated in bone marrow cells by the micronucleus test, chromosome aberration assay and comet assay (DNA strand breaks). In addition, DNA damage was evaluated in soft tissues and organs like spleen, liver and kidney cells. The oxidative damage was assessed by selective biochemical parameters by the measurement of lipid peroxidation, reduced glutathione (GSH), glutathione S-transferase (GST) and catalase (CAT) activity in liver. Adult Swiss albino male mice were exposed to sodium fluoride in drinking water at the concentrations of 4, 12 and 20mg/L for 30 consecutive days. Control groups (vehicle and positive) were also included. Animals were sacrificed; bone marrow and soft tissue samples were collected and subjected to series of assays respectively. We observed that NaF exposure, at the various concentrations tested caused a significant increase in the frequency of micronucleus (MN) in polychromatic erythrocytes (PCEs), structural chromosome aberrations in bone marrow cells. With the exception of the spleen cells, DNA damage was observed in bone marrow cells as well as in kidney and liver cells. We found an increase in lipid peroxidation, and catalase activity as well as decrease in glutathione activity (GSH and GST) in liver of mice respectively which were exposed to sodium fluoride. In conclusion, the data obtained clearly documents that NaF exhibits genotoxic activity and enhanced oxidative damage in mouse model.

Fluoride compounds are naturally present in soil, water and food. DNA damage was observed in bone marrow cells as well as in kidney and liver cells

Link: http://www.ncbi.nlm.nih.gov/pubmed/23201538

EXCERPTS FROM NEWSWEEK MAGAZINE

FEBRUARY NINETEEN NINETY

Don't Drink the Water?
Brush your teeth, but the fluoride from your tap may not do much good - and may cause cancer

Excerpts from the Feb 5th, 1990 Newsweek article

Remember the great fluoride debate? Back in the 1950s, every voice of authority, from the U.S. Public Health Service to the PTA, supported adding fluoride to the water supply as an effective and totally safe way to promote healthy teeth...

The most incendiary results come from the National Toxicology Program (NTP), which in 1977 was ordered by Congress to determine whether fluoride causes cancer. This week NTP plans to release data showing that lab rats given fluoridated water had a higher rate of a rare bone cancer called osteosarcoma. According to a memo by the Environmental Protection Agency, "very preliminary data from recent health studies ... indicate that fluoride may be a carcinogen."

In fact, the debate never ended. Now it may explode as never before, posing new challenges to medical dogma and giving parents one more thing to worry about. Government researchers have new evidence that casts doubt on the benefits of fluoridation and suggests that it is not without risk.

Fluoridation proponents are already criticizing the NTP study, but it will be harder to discredit or ignore than the hundreds of earlier experiments, of varying quality and from around the world, that have linked fluoride to mottled teeth, skeletal damage, genetic defects and other ills. During the two-year experiment, rats and mice drank water with different levels of sodium fluoride. None of the animals drinking fluoride-free water developed cancer, nor did any of those drinking water with the lowest fluoride concentration, 11 parts per million (ppm). But of the 50 male rats consuming 45-ppm water, one developed osteosarcoma. Four of 80 male rats drinking 79-ppm fluoride developed osteosarcoma. No mice or female rats showed signs of bone cancer. Although the animals drank higher concentrations of fluoride than people do (the legal standard is four ppm), such megadosing is standard toxicological practice. It's the only way to detect an effect without using an impossibly large number of test animals to stand in for the humans exposed to the substance.

Although the final NTP report will not be released for months, several independent toxicologists find the results significant. Most important, the rats who did not drink fluoride did not get cancer, indicating that the malignancies are "*not a fluke*," says EPA scientist William Marcus.

There is also a convincing relationship between dose and response: the more fluoride, the more cancers. Pathologist David Kaufman of the University of North Carolina warns that the rat data must be examined to see if the cancers appeared in the long bones of the arms and legs, as osteosarcomas do in humans, or in other places, which might make the results less relevant to people. Still, Kaufman says the NTP data "*make fluoride look like a weak carcinogen.*"

If fluoride causes bone cancer in lab rats, then why, after 45 years of fluoridation, haven't researchers seen a rash of osteosarcomas in fluoridated cities? Because epidemiology is too crude to detect it even if the cancers are there. In the 1970s, the National Cancer Institute found no sign of higher cancer rates in fluoridated cities. But that reassuring finding may be misleading. According to Donald Taves, a fluoride expert, if the difference were anything less than 7 percent it would not be detectable. Another obstacle to definitive epidemiology is mobility: just because someone got osteosarcoma in a fluoridated city does not mean he had been living there all his life.

The NTP results assume an added importance when combined with recent data on the shrinking benefits of fluoridation. According to the American Dental Association (ADA), tooth decay is anywhere from 50 to 70 percent less in fluoridated areas. But figures from the National Institute of Dental Research (NIDR), part of the National Institutes of Health, suggest otherwise. A 1987 survey of almost 4O,OOO school children found that tooth decay had declined sharply everywhere. Children who had always lived in fluoridated areas had 18 percent less decay, compared with their peers who had lived in nonfluoridated areas. This 18 percent translates into a difference of fewer than one cavity per child. Similarly, in a 1986 paper in the British Journal Nature, Australian researcher Mark Diesendorf assessed 24 studies from eight countries and found that cavity rates had declined equally in fluoridated and nonfluoridated, areas, suggesting fluoridated water isn't that important.

How can that be? "*A good case can be made that it has to do with fluoride in toothpaste and rinses*," says dental-health expert Brian Burt of the University of Michigan. And even if drinking fluoridated water is slightly risky, there is no hint that fluoridated toothpaste—as long as you don't swallow any—is dangerous. Tooth decay may also be declining because of better diet and hygiene. Also, foods and beverages processed with fluoridated water are ubiquitous. As a result, argues Alan Gray, a leading pro-fluoridation dentist in Canada, "*it is becoming difficult to provide accurate, ethical advice*" about fluoridation.

Among environmental controversies, fluoridation is unique in that one side has consistently denied that questions of risk or benefit even exist. The ADA states, "*Antifluoridation groups attempt to create the illusion of a scientific controversy [which is] merely a ploy to create doubt about a well researched, well-demonstrated preventive measure.*" But even well-researched articles raise hackles. When, in 1988, Chemical & Engineering News presented a balanced report on fluoridation, it attracted the wrath of the medical establishment. Says Taves, "*Too many scientists lost their objectivity. This has become a religion on both sides*."

Safe water. And that undercut the scientific process. The NIDR kept files on people perceived as threats to fluoridation. Political decisions were at odds with expert advice: a panel convened by the surgeon general in 1983 expressed concern, in closed sessions, about skeletal and dental damage from fluoride. At one point, a member said, "*You would have to have rocks in your head, in my opinion, to allow your child much more than two parts per million [fluoride]*." Said another, "*I think we all agree on that.*" Even so, in 1986 EPA raised the fluoride standard from about two ppm to four.

This month EPA opened a review of the standard. Once EPA receives the official NTP report, it will establish a target "*safe*" fluoride level. The Safe Drinking Water Act requires that the level be zero for carcinogens, but the

standard may be based on what is technically feasible. Fluoridation can be stopped immediately, but many communities with naturally fluoridated water—up to 12 ppm—would have to remove it. As EPA wrestles with the standard, fears John Sullivan of the American Water Works Association, "*confusion will reign*": local laws will still require fluoridation, a practice that may cause cancer.

As they await EPA's decision, pro-fluoridationists are invoking arguments of social justice. Dental researcher Ernest Newbrun: of the University of California, San Francisco, contends that fluoridation promotes the health of children of "*all races and all socioeconomic classes*," not only those with enough money or discipline or access to the health system to take a fluoride supplement every day.

He and others think it is morally wrong not to provide the benefits of fluoride. Although the NIDR's and other surveys suggest that fluoride in toothpastes and dental rinses also ensures healthy teeth for those who use the products, those who do not might suffer.

No one can foresee how the fluoride debate will play out this time. But since the 1950s, the country's environmental consciousness has been heightened. In the end, deciding whether or not to fluoridate turns less on science than on values. The sheer weight of good research may finally, after four decades, begin to inform those judgments and even overwhelm the unscientific rhetoric that has characterized both sides of the debate for far too long.

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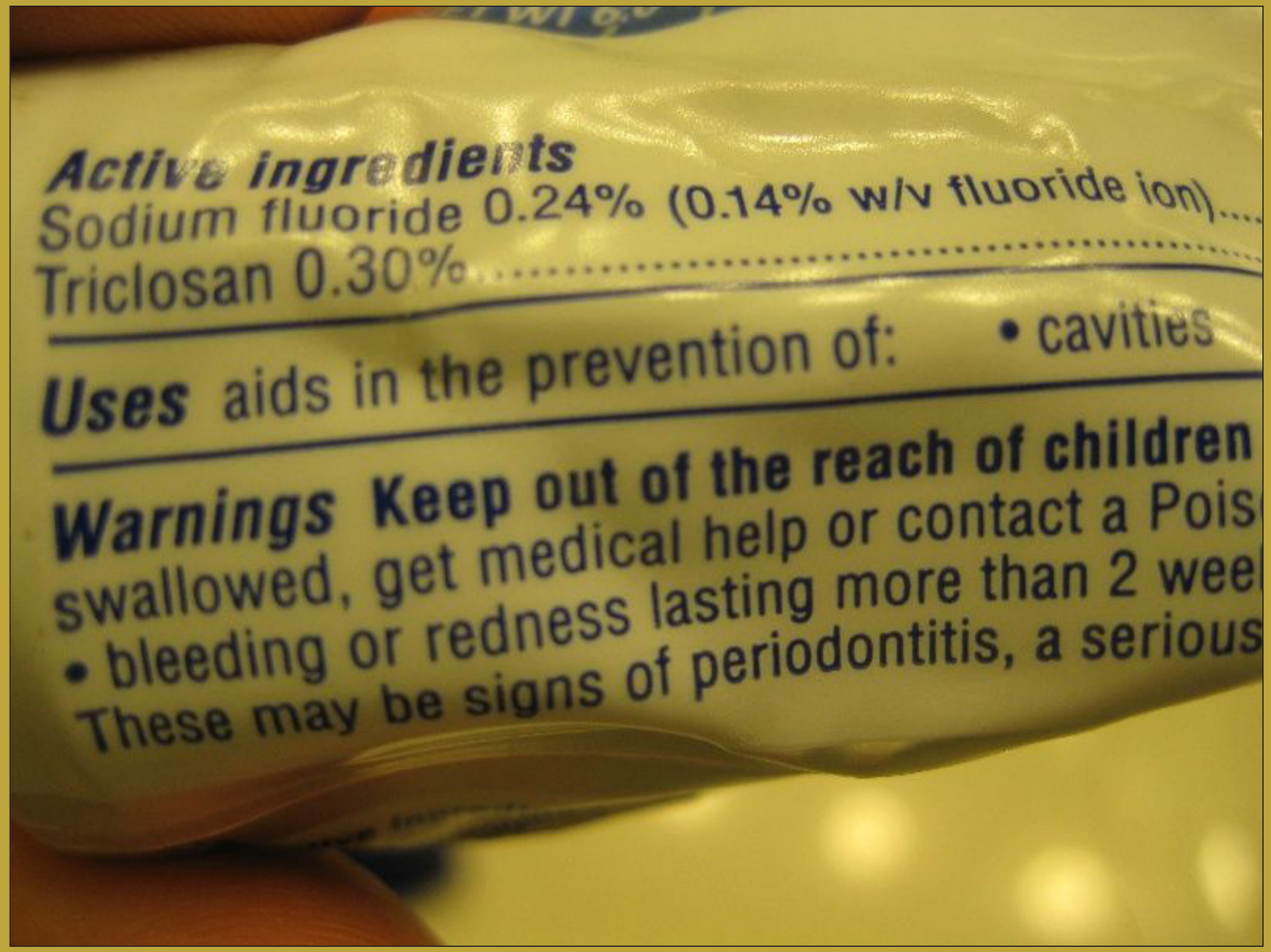
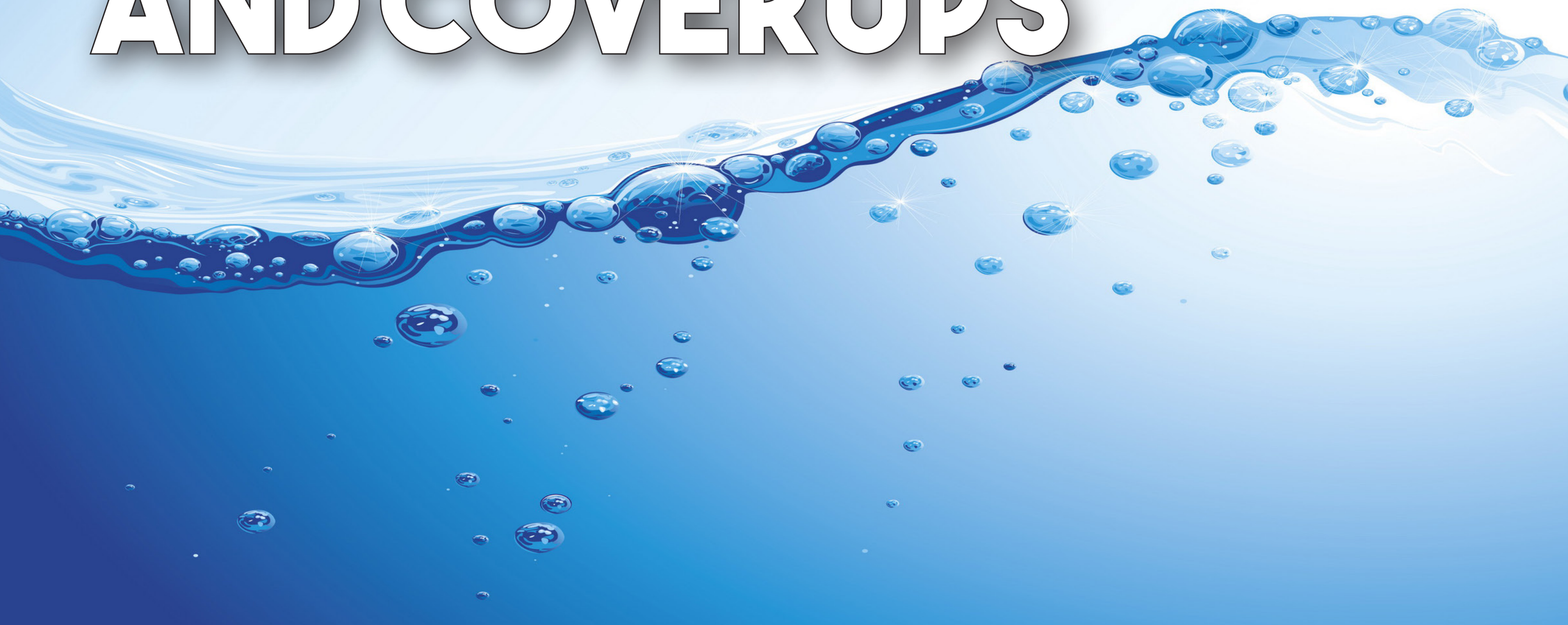
74 studies from 8 countries found that cavity rates had declined equally in fluoridated and nonfluoridated areas suggesting fluoridated water has absolutely no value at all and new evidence since then suggests that fluoridated water—because you also get fluoride from the air you breathe and the food you eat—is dangerous to human health.



FLUORIDE FACTS HORROR STORIES AND COVERUPS



Fluoride Facts, Horror Stories and Coverups

According to Dr Dean Burke, former chief biochemist at the National Cancer Institute, more that 50 000 Americans a year are dying of cancer caused by fluoridated drinking water.

"The lethal dose of NaF (artificial sodium fluoride) is 50 times smaller
than that of CaF2 (a naturally-occurring calcium fluoride)."
~ Dr. Hardy Limeback, biochemist and Professor of Dentistry,
University of Toronto, former consultant to the Canadian Dental Association

In 1998 Guan et al. gave similar doses of fluoride as used by the Mullenix group and found that several key chemicals in the brain—those that form the membrane of brain cells—were substantially depleted in rats given fluoride, as compared to those who did not receive fluoride.

30% of industrial waste from semiconductor plants is fluorine-containing waste.
"There were statutory limits on the amounts of certain potentially harmful ingredients such as
arsenic, fluorine, lead and mercury, which could be included in animal feed."
~ Volume 13: Industry Processes and Controls: http://www.just-think-it.com/chaptef2.htm

Community water systems in the United States use one of three additives for water fluoridation.
Decisions on which additive to use are based on cost of product,
product-handling requirements, space availability, and equipment.

From the CDC, the three types of fluoride water additives are:

• Fluorosilicic acid: a water-based solution used by most water systems in the United States. Fluorosilicic acid is also referred to as hydrofluorosilicate, FSA, or HFS.
• Sodium fluorosilicate: a dry additive, dissolved into a solution before being added to water.
•Sodium fluoride: a dry additive, typically used in small water systems, dissolved into a solution before being added to water.

Source: http://www.cdc.gov/fluoridation/factsheets/engineering/wfadditives.htm

Water fluoridation is the ideal solution for industry's fluoride waste disposal problem. Like the tall smoke stack introduced a decade earlier, it diverts and disperses pollutants far and wide. Chemicals that would cost $7,000 per tanker to dispose of are sold instead to cities at $265 to at least $722 per ton. Consequently, the phosphate fertilizer manufacturers invest millions of dollars in grants and lobbying of government officials to promote water fluoridation.

Source: "Fluoridation: License to Dump Toxic Waste In The Name of Public Health," Health Action Network, Fluoride Report No. 4, January 1997.

Contaminated with arsenic, lead, barium, cadmium, and mercury, no analyses of fluorosilicic acid are performed at the source, and only rudimentary analyses are performed at water treatment plants prior to their injection into public water systems. In many artificially fluoridated areas, the lead and copper content of the water exceeds EPA/ Safe Drinking Water Act standards. This occurs because of the caustic nature of fluorosilicic acid and its capacity to leach copper and lead from soldered pipe joints and brass fixtures.

Source: "Fluoridation: License to Dump Toxic Waste In The Name of Public Health", Health Action Network, Fluoride Report No. 4, January 1997.

"Fluoride is a carcinogen by any standard we use"
~ Dr. William Marcus, Ph.D, EPA Scientist, Food & Water Journal, Summer 1998

"Fluorides are general protoplasmic poisons, probably because of their capacity to modify the metabolism of cells by changing the permeability of the cell membrane and by inhibiting certain enzyme systems."
~ Journal of the American Medical Association, September 18, 1943

"As a toxicologist involved in fluoride research for over ten years, I was stunned by the Calgary Regional Health Authority's glib comments proclaiming water fluoridation safe. The 'fifty years' of studies about fluoride safety, do not exist. The "*ongoing intensive research on fluorides and fluoridation*", does not exist, certainly none investigating safety."
~ Dr. P. Mullenix, Ph.D.

The federal maximum contaminant level (MEL) for lead is 15 parts per billion (ppb), 5 ppb for arsenic but 4,000 ppb for fluoride. If you have cereal with milk and a Coke, you have overdosed on fluoride. You have exceeded the American Dental Association's recommended daily dose by 230%.

Fluoride advocates don't want you to know that the chemicals used for fluoridation are not pharmaceutical quality. They are derived from the waste byproducts of fertilizer manufacturing and contain heavy metals such as lead and arsenic. Chemifloc Ltd., a fluoridation chemical manufacturer, clearly states this in a letter reprinted here, at top right:

NSF, the corporation that developed drinking water standards stated in a letter reprinted at lower right that the "*most common contaminant in [fluoridated water] is arsenic*"

Chemifloc Ltd.
Shannon, Co. Clare, Ireland

February, 1997

I would like to inform you that Chemifloc does not supply Fluosilicic Acid which is derived from the fertilizer industry - we supply a manufactured product which is of high quality. Typically, manufactured Fluosilicic Acid contains only 5-10% of the arsenic levels which are found in the fertilizer derived material. It didn't matter if ours had substantially less arsenic.

In any event you can be happy that not only is the Eastern Health Board ensuring that your water is fluoridated, they're also seeing you get a little extra arsenic at no charge. Personally I would prefer to do without the arsenic.

Sincerely,

E.A. Storey

Link: http://www.nofluoride.com/chemifloc.htm

"The results in Table 1 indicate that the most common contaminant in these products [fluoridated water] is Arsenic.. The U.S. EPA recently proposed lowering the maximul MCL (Maximum Contaminent Level) from 50 ppb to 5 ppb. The end results is that future tests of fluoridation chemicals may result in increased product failures [drinking water exceeding maximum Arsenic levels] when the lower Arsenic MCL of 5 ppb is promulgated."

"Other significant contanimants found.. is Lead"

General Manager
Drinking Water Additives Certification Program
NSF International

Link: http://www.nofluoride.com/nsf.htm

In 1986-87, the largest study on fluoridation and tooth decay ever was performed. The subjects were 39,000 school children between 5 and 17 living in 84 areas around the country. A third of the places were fluoridated, a third were partially fluoridated, and a third were not. Results indicate no statistically significant differences in dental decay between fluoridated and unfluoridated cities.

According to a Sierra Club study, people in unfluoridated developing nations have fewer dental caries than those living in industrialized nations.

A World Health Organization survey reports a decline of dental decay in Western Europe, which is 98% unfluoridated. They state that western Europe's declining dental decay rates are equal to and sometimes better than those in the U.S.

A 1992 University of Arizona study yielded surprising results when they found that "*the more fluoride a child drinks, the more cavities appear in the teeth.*"

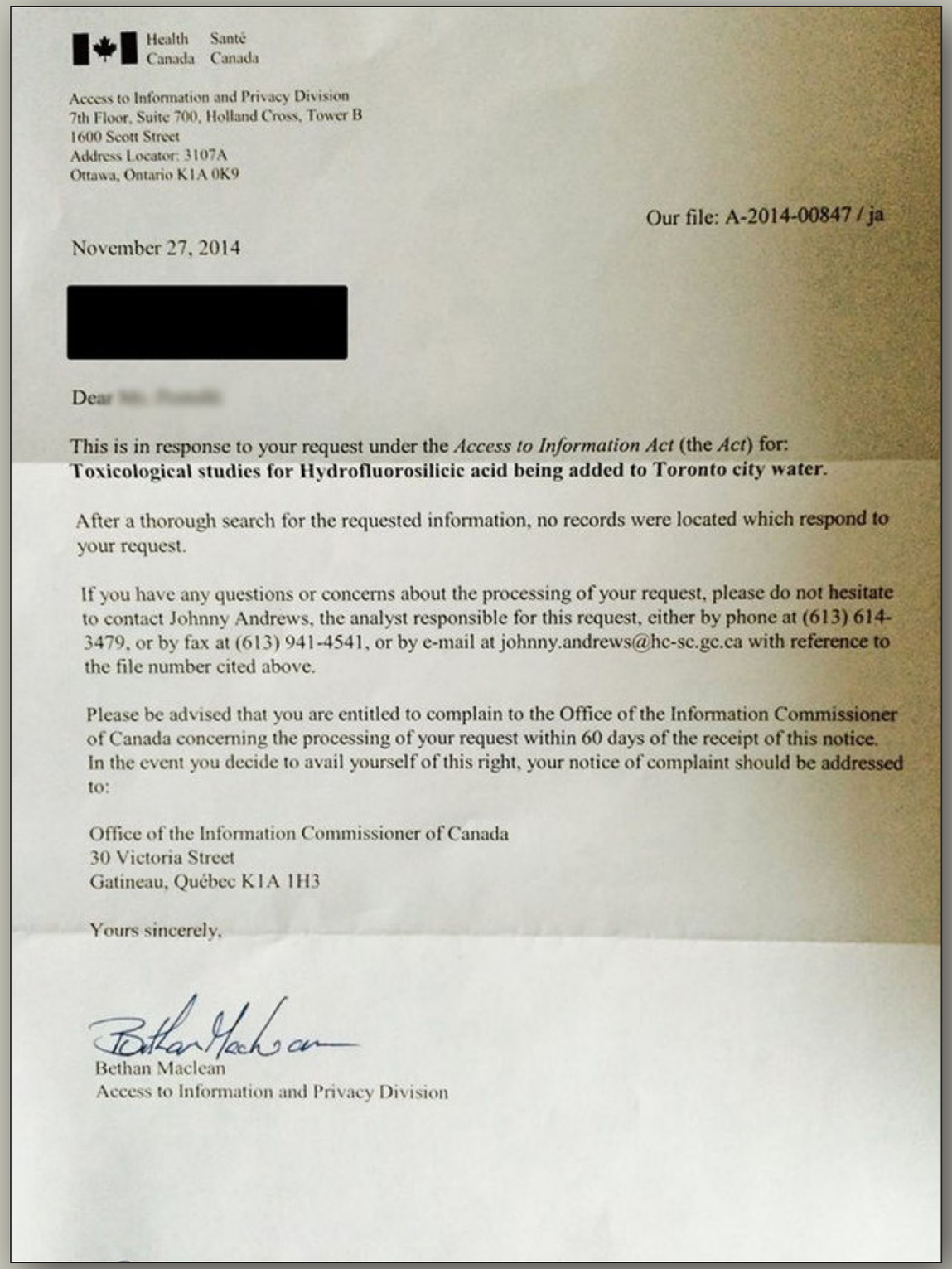
Research does not support the effectiveness of fluoridation for preventing tooth disease. Also, purported benefits are supposedly for children, not adults and senior citizens. At about age 13, any advantage fluoridation might offer comes to an end, and less than 1% of the fluoridated water supply reaches this population. Finally, fluoridation has never been proven safe. On the contrary, several studies directly link fluoridation to skeletal fluorosis, dental fluorosis, and several rare forms of cancer. This alone should frighten us away from its use.

May 1993 - Kodiak, Alaska (Old Harbor): The population was warned not to consume water due to high fluoride levels. They were also cautioned against boiling the water, since this concentrates the substance and worsens the danger. Although equipment appeared to be functioning normally, 22-24 ppm of fluoride was found in a sample. [Floyd: i.e. 22 to 24 times more than was supposed to be]

Fluoride could only be legally disposed of at a great cost to industry. As Dr. Bill Marcus explains, "*There are prescribed methods for disposal and they're very expensive. Fluoride is a very potent poison. It's a registered pesticide, used for killing rats or mice. If it were to be disposed of, it would require a class-one landfill. That would cost the people who are producing aluminum or fertilizer about $7000+ per 5000- to 6000-gallon truckload to dispose of it. It's highly corrosive.*"

Not all fluoride poisoning is accidental. For decades, industry has knowingly released massive quantities of fluoride into the air and water. Disenfranchised communities, with people least able to fight back, are often the victims. Medical writer Joel Griffiths relays this description of what industrial pollution can do, in this case to a devastatingly poisoned Indian reservation: "*Cows crawled around the pasture on their bellies, inching along like giant snails. So crippled by bone disease they could not stand up, this was the only way they could graze. Some died kneeling, after giving birth to stunted calves. Others kept on crawling until, no longer able to chew because their teeth had crumbled down to the nerves, they began to starve...*"

"*They were the cattle of the Mohawk Indians on the New York-Canadian St. Regis Reservation during the period 1960-1975, when industrial pollution devastated the herd—and along with it, the Mohawks' way of life. Mohawk children, too, have shown signs of damage to bones and teeth.*" Mohawks filed suit against the Reynolds Metals Company and the Aluminum Company of America (Alcoa) in 1960, but ended up settling out of court, where they received $650,000 for their cows. Fluoride is one of industry's major pollutants, and no one remains immune to its effects. In 1989, 155,000 tons were being released annually into the air; and 500,000 tons a year were disposed of in our lakes, rivers, and oceans.



Health Canada Santé Canada

Access to Information and Privacy Division
7th Floor, Suite 700, Holland Cross, Tower B
1600 Scott Street
Address Locator: 3107A
Ottawa, Ontario K1A 0K9

Our file: A-2014-00847 / ja

November 27, 2014

[redacted]

Dear [redacted]

This is in response to your request under the *Access to Information Act* (the *Act*) for:
Toxicological studies for Hydrofluorosilicic acid being added to Toronto city water.

After a thorough search for the requested information, no records were located which respond to your request.

If you have any questions or concerns about the processing of your request, please do not hesitate to contact Johnny Andrews, the analyst responsible for this request, either by phone at (613) 614-3479, or by fax at (613) 941-4541, or by e-mail at johnny.andrews@hc-sc.gc.ca with reference to the file number cited above.

Please be advised that you are entitled to complain to the Office of the Information Commissioner of Canada concerning the processing of your request within 60 days of the receipt of this notice. In the event you decide to avail yourself of this right, your notice of complaint should be addressed to:

Office of the Information Commissioner of Canada
30 Victoria Street
Gatineau, Québec K1A 1H3

Yours sincerely,

Bethan Maclean
Access to Information and Privacy Division

In 1977, Dr. John Yiamouyiannis and Dr. Dean Burk, former chief chemist at the National Cancer Institute, released a study that linked fluoridation to 10,000 cancer deaths per year in the U.S. Their inquiry, which compared cancer deaths in the ten largest fluoridated American cities to those in the ten largest unfluoridated cities between 1940 and 1950, discovered a 5% greater rate in the fluoridated areas.

According to a National Toxicology Report, due in 1980 but not released until 1990, out of 130 male rats that ingested 45 to 79 ppm of fluoride, 5 developed osteosarcoma, a rare bone cancer. There were cases, in both males and females at those doses, of squamous cell carcinoma in the mouth. Both rats and mice had dose-related fluorosis of the teeth, and female rats suffered osteosclerosis of the long bones. Footnote: in 1986 the EPA "*increased*" the dosage of Fluoride from 2.4ppm to 4ppm.

"*It is difficult to see how EPA can fail to regulate fluoride as a carcinogen in light of what NTP has found. Osteosarcomas are an extremely unusual result in rat carcinogenicity tests. Toxicologists tell me that the only other substance that has produced this is radium. The fact that this is a highly atypical form of cancer implicates fluoride as the cause. Also, the osteosarcomas appeared to be dose-related, and did not occur in controls, making it a clean study.*"
~ the opinion of a federal scientist who preferred to remain anonymous, released on February 22, 1990 in the Medical Tribune, an international medical news weekly received by 125,000 doctors.

Public health officials such as Dr. Gray in British Columbia and Dr. Colquhoun in New Zealand found no benefit from fluoridation. When they reported these results, they immediately lost their careers. As Ralph Nader once said, if they admit they're wrong on fluoridation, people would ask, and legitimately so, what else have they not told us, right?

Most of western Europe has rejected fluoridation on the grounds that it is unsafe. In 1971, after 11 years of testing, Sweden's Nobel Medical Institute recommended against fluoridation, and the process was banned. The Netherlands outlawed the practice in 1976, after 23 years of tests. France decided against it after consulting with its Pasteur Institute and West Germany, now Germany, rejected the practice because the recommended dosage of 1 ppm was "*too close to the dose at which long-term damage to the human body is to be expected*." Dr. Lee sums it up: "*All of western Europe, except one or two test towns in Spain, has abandoned fluoride as a public health plan. It is not put in the water anywhere. They all established test cities and found that the benefits did not occur and the toxicity was evident.*"

There is also a moral issue in the debate that has largely escaped notice. According to columnist James Kilpatrick, it is "*the right of each person to control the drugs he or she takes*." Kilpatrick calls fluoridation compulsory mass medication, a procedure that violates the principles of medical ethics.

Only a small margin separates supposedly beneficial fluoride levels from amounts that are known to cause adverse effects. Dr. James Patrick, a former antibiotics research scientist at the National Institutes of Health, describes the predicament: "*[There is] a very low margin of safety involved in fluoridating water. A concentration of about 1 ppm is recommended ... in several countries, severe fluorosis has been documented from water supplies containing only 2 or 3 ppm. In the development of drugs ... we generally insist on a therapeutic index (margin of safety) of the order of 100; a therapeutic index of 2 or 3 is totally unacceptable, yet that is what has been proposed for public water supplies...*"

The Journal of the Canadian Dental Association states that "*Fluoride supplements should not be recommended for children less than 3 years old.*" Since these supplements contain the same amount of fluoride as water does, they are basically saying that children under the age of three shouldn't be drinking fluoridated water at all, under any circumstances.

December 1991 - Benton Harbor Michigan: A faulty pump allowed approximately 900 gallons of hydrofluosilicic acid to leak into a chemical storage building at the water plant. City engineer Roland Klockow stated, "*The concentrated hydrofluosilicic acid was so corrosive that it ate through more than two inches of concrete in the storage building.*"

July 1991 - Porgate, Michigan: After a fluoride injector pump failed, fluoride levels reached 92 ppm and resulted in approximately 40 children developing abdominal pains, sickness, vomiting, and diarrhea at a school arts and crafts show.

November 1979 - Annapolis, Maryland: One patient died and eight became ill after renal dialysis treatment. Symptoms included cardiac arrest (resuscitated), hypotension, chest pain, difficulty breathing, and a whole gamut of intestinal problems. Patients not on dialysis also reported nausea, headaches, cramps, diarrhea, and dizziness. The fluoride level was later found to be 35 ppm; the problem was traced to a valve at a water plant that had been left open all night.

Another concern is that fluoride is not found only in drinking water; it is everywhere. Fluoride is found in foods that are processed with it, which, in the United States, include nearly all bottled drinks and canned foods. Researchers writing in The Journal of Clinical Pediatric Dentistry have found that fruit juices, in particular, contain significant amounts of fluoride. In a recent study, a variety of popular juices and juice blends were analyzed and it was discovered that 42% of the samples examined had more than 1 ppm of fluoride, with some brands of grape juice containing much higher levels - up to 6.8 ppm!

Cooking can greatly increase a food's fluoride content. Peas, for example, contain 12 micrograms of fluoride when raw and 1500 micrograms after they are cooked in fluoridated water.

It's interesting to note that in the 1950s, fluoridated toothpastes were required to carry warnings on their labels saying that they were not to be used in areas where water was already fluoridated. Crest toothpaste went so far as to write: "*Caution: Children under 6 should not use Crest.*" These regulations were dropped in 1958, although no new research was available to prove that the overdose hazard no longer existed.

How safe is all this fluoride? According to scientists and informed doctors, such as Dr. John Lee, it is not safe at all. Dr. Lee first took an anti-fluoridation stance back in 1972, when as chairman of an environmental health committee for a local medical society, he was asked to state their position on the subject. He stated that after investigating the references given by both pro- and anti-fluoridationists, the group discovered three important things: "*One, the claims of benefit of fluoride, the 60% reduction of cavities, was not established by any of these studies. Two, we found that the investigations into the toxic side effects of fluoride have not been done in any way that was acceptable. And three, we discovered that the estimate of the amount of fluoride in the food chain, in the total daily fluoride intake, had been measured in 1943, and not since then. By adding the amount of fluoride that we now have in the food chain, which comes from food processing with fluoridated water, plus all the fluoridated toothpaste that was not present in 1943, we found that the daily intake of fluoride was far in excess of what was considered optimal...*"

According to a 1989 National Institute for Dental Research study, 12% of children living in areas fluoridated at 1 ppm develop dental fluorosis, that is, permanently stained, brown mottled teeth. Up to 23% of children living in areas naturally fluoridated at 4 ppm develop severe dental fluorosis.

The publication Health Effects of Ingested Fluoride, put out by the National Academy of Sciences, reports that in areas with optimally fluoridated water (*1 ppm, either natural or added*), dental fluorosis [that is, permanently stained, brown mottled teeth] affected 8 to 51% of the population. Recently, a prevalence of slightly over 80% was reported in children 12-14 years old in Augusta, Georgia.

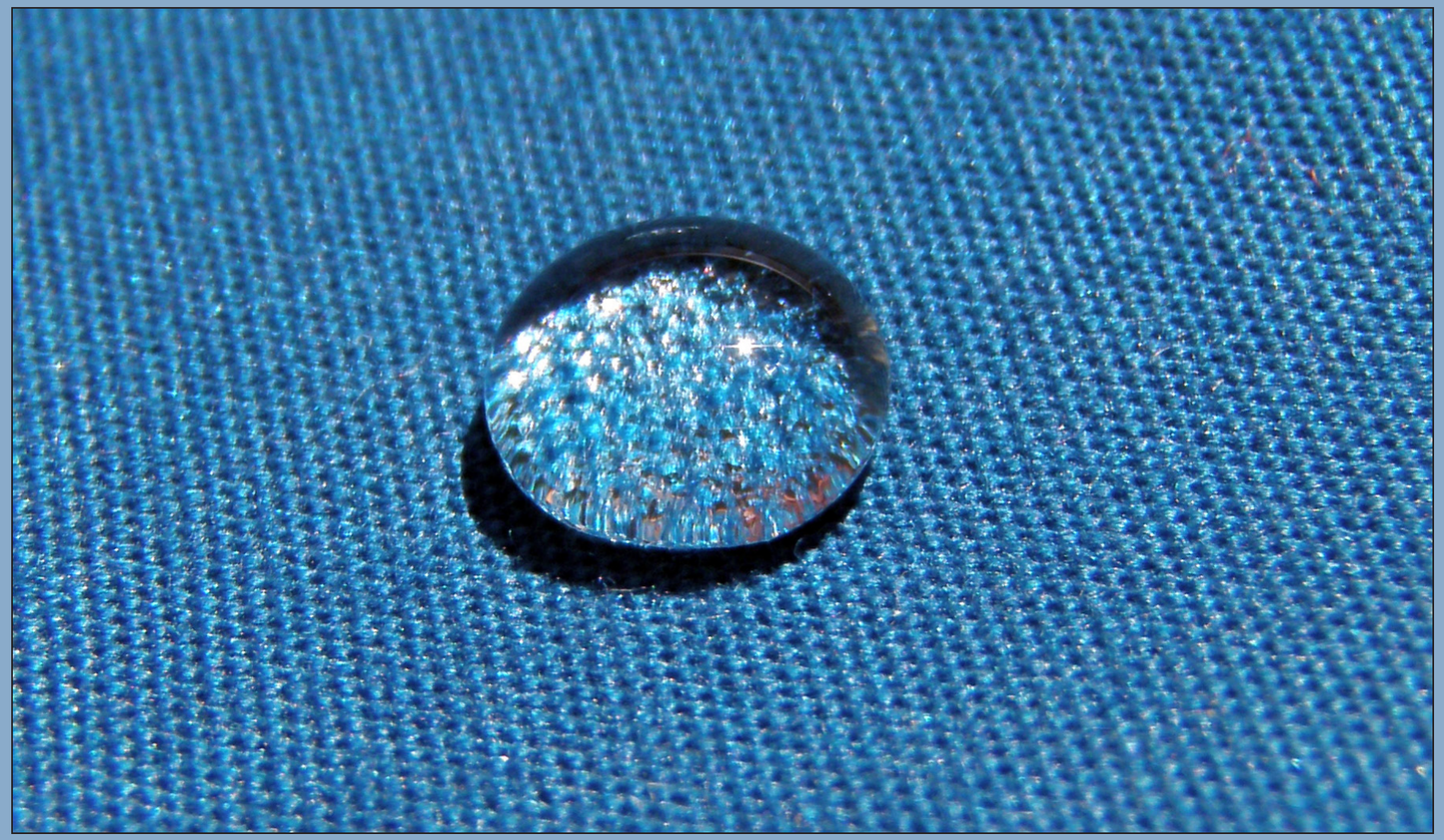
The American Journal of Public Health says that "*...brittleness of moderately and severely mottled teeth may be associated with elevated caries levels*." In other words, in these cases the fluoride is causing the exact problem that it's supposed to prevent. Yiamouyiannis adds, "*In highly naturally-fluoridated areas, the teeth actually crumble as a result. These are the first visible symptoms of fluoride poisoning*."

In May 1992, 260 people were poisoned, and one man died, in Hooper Bay, Alaska, after drinking water contaminated with 150 ppm of fluoride. The accident was attributed to poor equipment and an unqualified operator. Was this a fluke? Not at all. Over the years, the CDC has recorded several incidents of excessive fluoride permeating the water supply and sickening or killing people.

Japan has reduced the amount of fluoride in their drinking water to one-eighth of what is recommended in the U.S.
Today, common fluoride levels in toothpaste are 1000 ppm. Research chemist Woodfun Ligon notes that swallowing a small amount adds substantially to fluoride intake. Dentists say that children commonly ingest up to 0.5 mg of fluoride a day from toothpaste.

The National Academy Of Sciences (NAS) stated in 1977 that, for the average individual, a retention of 2mg fluoride/day would result in crippling skeletal fluorosis after 40 years.

Children, the elderly and any person with impaired kidney function (*which includes many AIDS patients*), are in the high risk group for fluoride poisoning and must be warned to monitor their fluoride intake. Also at high risk are people with immunodeficiencies, diabetes and heart ailments, as well as anyone with calcium, magnesium and Vitamin C deficiencies.



Studies show that adults can absorb up to 0.5 mg per day of fluoride from toothpaste. Small children, even if a pea-size amount of toothpaste is used, will absorb up to 0.5 mg of fluoride per day, more if the child is younger and has less swallowing control. Bubblegum-flavored dentifrice obviously is very inviting for children.

Due to the presence of fluoride, since April 1997 all toothpaste sold in the US must carry a warning label, advising parents what to do if their child swallows more than the pea-size brushing amount.

Dentists make higher profits in fluoridated areas and through fluoride use! As a result of mottled enamel, many more restorative measures are necessary, such as braces, bridges, etc. For the ADA/CDA, this condition is a real money-maker, because cosmetic dentistry is far more lucrative than cavity repair. In addition, there is an abundance of evidence in the scientific literature that fluoride causes a delay in the normal shedding of the "*baby*" teeth, and their replacement by permanent teeth. This delay has been shown to increase the number of children with malpositioned teeth. Again, braces are far more expensive than fillings.

There are also several studies linking aluminum with fluoride, showing that the bioavailability of aluminum is increased in the presence of fluorides, causing aluminum in the brain to double in treated animals. According to an October 28, 1992 Wall Street Journal Article about a study conducted by Varnier JA, et al.: "Rats fed the highest doses developed irregular mincing steps characteristic of senile animals... Post mortem examination of the rat brains disclosed 'substantial cell loss in structures associated with dementia -- the neo-cortex and hippocampus'." Similar data was published by Varner, Jansen and others in Brain Research in 1998. Alzheimer's Disease, first diagnosed by Dr. Alois Alzheimer in 1907, is now the #4 killer for every person over 60 in the US. Every 2nd person over 70 will develop Alzheimer's.

Darlene Sherrell, not only discovered that the original Roholm/Hodge fluoride safety figures had been mis-calculated and then persisted with the help of Dr. Bob Carton and Senator Bob Graham in her efforts to get the National Research Council (NAS/NRC) to adopt the new figures—which had even been corrected by Hodge himself in 1979—also managed to change the law in Michigan, giving people the right to vote on fluoridation. Michigan was the first state in the US to repeal their mandatory fluoridation law.

A 1944 editorial in the Journal of the American Dental Association (JADA) states: "*We do know that the use of drinking water containing as little as 1.2 to 3ppm of fluorine will cause such developmental disturbances in bones as osteosclerosis, spondylosis and osteopetrosis, as well as goitre.*"

Steyn writes in 1962 that drinking water containing as little as 1 to 2 ppm of fluorine can cause serious disturbances of general health and especially in normal thyroid gland function and in the normal processes of calcium-phosphate metabolism (parathyroid function).

In 1978 George Waldbott writes that in most cases of poisoning from fluoridated water in which he had occasion to study the action of the thyroid gland, it's function was low. He cites a case of a 33-year-old male who exhibited typical manifestations of pre-skeletal fluorosis and a basal metabolism rate of -22, indicative of hypothyroidism. Within three months after the man ceased consuming fluoridated water, the thyroid function had returned to normal (BMR=0). In addition, Waldbott writes that "*simultaneously, other symptoms associated with low grade fluoride poisoning -- including excessive thirst, headaches, blurred vision, arthritis in shoulders, elbows, knees, and gastrointestinal disturbances -- also disappeared.*"

In 1995, Mullenix and co-workers showed that rats given fluoride in drinking water at levels that give rise to plasma fluoride concentrations in the range seen in humans suffer neurotoxic effects that vary according to when the rats were given the fluoride—as adult animals, as young animals, or through the placenta before birth. Those exposed before birth were born hyperactive and remained so throughout their lives. Those exposed as young or adult animals displayed depressed activity.

Another 1998 publication by Varner, Jensen and others reported on the brain- and kidney damaging effects in rats that were given fluoride in drinking water at the same level deemed "*optimal*" by pro-fluoridation groups, namely 1 part per million (1ppm). Even more pronounced damage was seen in animals that got the fluoride in conjunction with aluminum. These results are especially disturbing because of the low dose level of fluoride that shows the toxic effect in rats, and rats are more resistant to fluoride than humans.

Epidemiology studies from China show decreases in I.Q. in children who get more fluoride than the control groups of children in each study. These decreases are about 5 to 10 I.Q. points in children aged 8 to 13 years.

Regarding the effectiveness of fluoride in reducing dental cavities, there has not been any double-blind study of fluoride's effectiveness as a caries preventative. There have been many, many small scale, selective publications on this issue that proponents cite to justify fluoridation, but the largest and most comprehensive study, one done by dentists trained by the National Institute of Dental Research, on over 39,000 school children aged 5-17 years, shows No Significant Difference (*in terms of decayed, missing and filled teeth*) among caries incidences in fluoridated, non-fluoridated and partially fluoridated communities. The latest publication on the 50 year fluoridation experiment in two New York cities, Newburgh and Kingston, shows the same thing.

...In addition to our concern over the toxicity of fluoride, we note the uncontrolled—and apparently uncontrollable —exposures to fluoride that are occurring nationwide via drinking water, processed foods, fluoride pesticide residues and dental care products. A report in The Wall Street Journal on December 21st, 1998 noted that, according to the Centers for Disease Control, at least 22% of America's children now have dental fluorosis and this is just one indication of this uncontrolled, excess exposure. For governmental and other organizations to continue to push for more exposure in the face of current levels of over-exposure coupled with an increasing crescendo of adverse toxicity findings is irrational and irresponsible at best. Thus, we took the stand that a policy which makes the public water supply a vehicle for disseminating this toxic and prophylactically useless (*via ingestion, at any rate*) substance is wrong.

We have also taken a direct step to protect the employees we represent from the risks of drinking fluoridated water. We applied EPA's risk control methodology, the Reference Dose, to the recent neurotoxicity data. The Reference Dose is the daily dose, expressed in milligrams of chemical per kilogram of body weight, that a person can receive over the long term with reasonable assurance of safety from adverse effects. Application of this methodology to the Varner et al. data leads to a Reference Dose for fluoride of 0.000007 mg/kg/day. Persons who drink about one quart of fluoridated water from the public drinking water supply of the District of Columbia while at work receive about 0.01 mg/kg/day from that source alone. This amount of fluoride is more than 100 times the Reference Dose. On the basis of these results the union filed a grievance, asking that EPA provide unfluoridated drinking water to its employees. The implication for the general public of these calculations is clear. Recent, peer-reviewed toxicity data, when applied to EPA's standard method for controlling risks from toxic chemicals, require an immediate halt to the use of the nation's drinking water reservoirs as disposal sites for the toxic waste of the phosphate fertilizer [and Aluminum] industry

In 1998, Dr. Bob Carton wrote: "Based on Roholm's work and other recent studies, there is every reason to believe that the increasing number of people with carpal-tunnel syndrome and arthritis- like pains are due to the mass fluoridation of drinking water"
~ EPA Scientists, 1998

Many psychoactive drugs including Prozac, Paxil and Luvox are fluorinated medications. Rohypnol, the infamous date-rape drug, is fluorinated Valium, which is about 20-30 times more potent than Valium alone.

Notes From Green Tea & Fluoride

Fluoride in tea is much higher than the Maximium Contaminant Level (MCL) set for fluoride in drinking water.
~ Green Tea & Fluoride

Tea leaves accumulate more fluoride (*from pollution of soil and air*) than any other edible plant.
~ Green Tea & Fluoride

A website by a pro-fluoridation infant medical group lists a cup of black tea to contain 7.8 mgs of fluoride, roughly the same amount as if one were to drink 7.5 quarts of water in an area fluoridated at 1ppm.
~ Green Tea & Fluoride

Some British and African studies from the 1990's showed a daily fluoride intake of between 5.8 mgs and 9 mgs a day from tea alone [*equal to drinking 5 to 9 quarts of fluoridated water per day!*].
~ Green Tea & Fluoride

Studies conducted on tea consumption in Tibetan children by Cao et al. found both dental (51.2%) and skeletal (32.83%) fluorosis, mainly as a result from drinking tea. More studies by Cao and others reported similar results, as did a study from Chile showing dental fluorosis risks in 22.1% of the children consuming tea as a main beverage. Many similar studies on tea as well as other beverages have been published in the journals of the American Dental Association (ADA) or American Medical Association (AMA) themselves.
~ Green Tea & Fluoride

Studies on hydrofluoric-acid workers from an electronics company documented that, among the influences of fluorine- containing foodstuff on fluoride content in the biological fluids, the effect of black tea and/or green tea intake was "*particularly remarkable*." Measuring the urine and serum levels of fluorine ion, in the case of the non-hydrofluoric-acid workers, the concentration increased to about double of the control value. Similarly in a diet test on volunteers, the concentration increased about six times.
~ Green Tea & Fluoride

To make matters much worse for human health, fluorides in teas are found together with aluminum. The combination of aluminum and fluorides in tea is of urgent concern, due to the increased damage done by fluorides when in the presence of aluminum, especially neurological and renal damage.
~ Green Tea & Fluoride

The fluoride/aluminum association is of particular importance as it relates to Alzheimer's Disease. Aluminum by itself is not readily absorbed by the body. However, in the presence of fluoride ions, the fluoride ions combine with the aluminum to form aluminum fluoride, which is absorbed by the body. In the body, the aluminum eventually combines with oxygen to form aluminum oxide or alumina. Alumina is the compund of aluminum that is found in the brains of Alzheimer's disease sufferers. In the brain, proteins bind to the alumina, and "*that is the key to the plaques and tangles which are the hallmarks of this terrible disease*."

In a study by Dr. Robert Isaacson at the State University of New York, aluminum fluoride was added to the rats diet. This, contrary to normal expectations, passed through the brain barrier and gave the rats short term memory loss, smell sensory loss, unsteady gait, and loss of structures of the neo-cortex and hippocampus—all symptoms of Alzheimer's. A Varner and Jensen study conducted with Isaacson confirmed this in 1998.

Toothpaste also contains a significant quantity of Aluminum (Al), more so, when packed in Al tubes. That children often ingest too much toothpaste is well established and the reason why since April 1997 a poison warning is to be placed on all fluoride-containing toothpastes in the US. It is an absolute disgrace that this is not the same in Canada, especially when the US FDA has issued several Import Alerts and customs detention orders, documenting fluoride amounts double that of permissable content originating in Canada.

It is only in the last two decades during which endocrinology has progressed so rapidly, that now over 150 symptoms and associations can be identified in hypothyroidism. Almost all correlate with known symptoms of fluoride poisoning.

Most of the double-blind test results of fluoride poisoning found in Moolenburgh's study on water containing 1ppm of fluoride -- which led to the ban of fluoridation in Holland -- are now recognized symptoms of hypothyroidism.

Chile banned fluoridation because of research by the world-reknowned researcher and Nobel price winner, Dr. Albert Schatz, which showed a link to infant deaths due to fluoridation.

Learning disorders such as Attention Deficit Hyperactivity Disorder (ADHD) did not knowingly exist before the fluoridation of public water supplies began. In the 1950's ADHD spread rapidly among school children and gained much exposure in the medical science and health literature. In 1963 the U.S. PHS listed dozens of symptoms associated with hyperactivity and officially changed the name to "*minimal brain dysfunction*". By the the 1970's some leading authorities noted that this disorder appeared to lie at the root of nearly every type of childhood behaviour problem, and had become the most commonly diagnosed illness among childhood counsellors. In 1987 the American Medical Association acknowledged that brain damage had become the leading disability reported by elementary schools, and "*one of the most common referral problems to psychiatry outpatients clinics*."

If you drink 1 cup (6oz) of green/black tea a day, with fluoride content of 5mg, you can expect Chronic Skeletal Fluorosis to appear as follows, based on a 100 lb person:

Phase 1: within 5 years: sporadic pain; stiffness in joints; osteosclerosis of pelvis and vertebral column.
Phase 2: after 10 years: chronic joint pain; arthritic symptoms; slight calcification of ligaments; increased osteoclerosis/cancerous bones; with/without osteoporosis of long bones.
Phase 3: after 23 years: crippling fluorosis, limitation of joint movement; calcification of ligaments/neck, vertical column; crippling deformities/spine major joints; muscle wasting;neurological defects/compression of spinal chord.

The Environmental Protection Agency (EPA) has previously estimated that levels of fluoride in/on food from the agricultural use of Cryolite plus fluoride levels in U.S. drinking water supplies results in a daily dietary intake of fluoride of approximately 0.095 mg/kg/day. For a person weighing 155 pounds, this would mean intake of 6.65mg/day from those two sources alone. That rate of consumption of fluoride will induce crippling fluorsis in 23 years.

A group of biologists and medical researchers at the University of Wisconsin in Madison, led by Warren P. Porter, completed a 5-year experiment putting mixtures of low levels of pesticide chemicals into the drinking water of male mice and carefully measuring the results. They reported that combinations of these chemicals—at levels similar to those found in the groundwater of agricultural areas of the U.S.—have measurable detrimental effects on the nervous, immune and endocrine systems. They say their research has direct implications for humans. Porter explains, "*To get a chemical into a cell you've got to have part of the chemical that's fat soluble so it can pass through the cell membrane. And part of it has to have a strong electrical charge because you need to attract the chemical to the part of the cell where you want to do the damage. The trouble is, the ways cells communicate, both within themselves and between each other, is by means of highly charged molecules, ions really. These things are being pumped across the membranes and moved around in cells. So when you take a chemical that you've designed that has a strong electrical charge and you put it in the middle of this tremendous stream of communication--I mean, a high school chemistry student could tell you there are going to be effects. There's just no way these things are not going to be biologically active. It's very important for people to understand that. This is a very real concern.*"

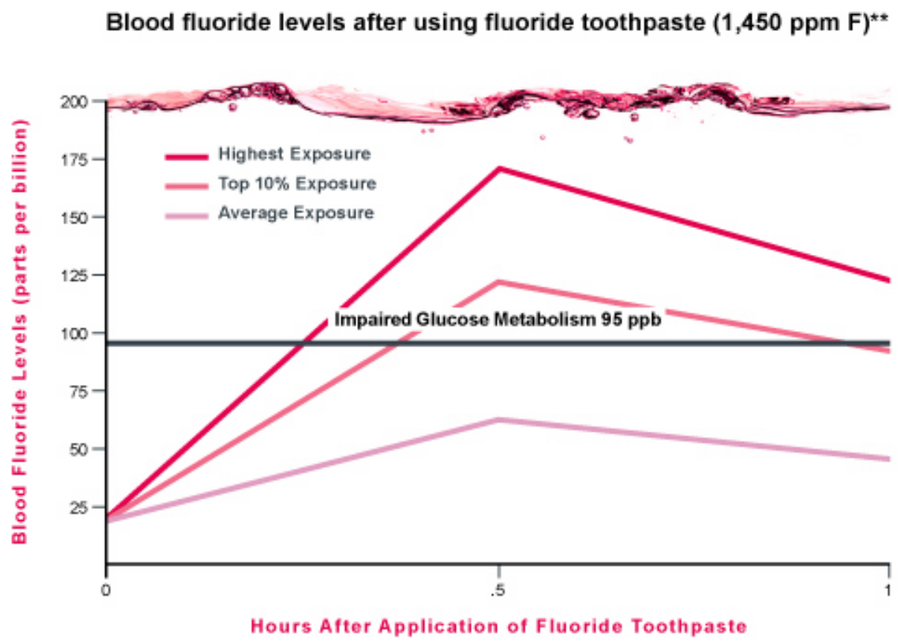
Fluorides lower the intelligence capacity of humans, with children, again, especially susceptible to early fluoride toxicity. IQ levels were significantly lower than children not exposed to fluorides in all age groups listed. [Li,X.S.,Zhi,J.L.,Gao,R.O.,"Effects of Fluoride Exposure on the Intelligence of Children", Fluoride, 1995]

Studies proving the neurotoxicity of fluoride in rats have been conducted by Dr. Phyllis Mullinex. In 1995 Mullenix and co-workers showed that rats given fluoride in drinking water at levels that give rise to plasma levels fluoride concentrations in humans, suffer neurotoxic effects that vary according to when the rats were given the fluoiride—as adult animals, as young animals, or thorugh the placenta before birth. Those exposed before birth were born hyperactive and remained so throughout their lives. Those exposed as young animals displayed depressed activity.

Fluoride causes cancer. In 1981, Dean Burk, for many decades Chief Chemist at the US National Cancer Institute, testified at congressional hearings, reporting that at least 40,000 cancer deaths in 1981 were attributable to fluoride. 40,000 cases that could have been prevented simply by not putting industry waste into the public water supply. Burk stated that fluoride causes more cancer, and causes it faster, than any other chemical.

1952: The Delaney Committee 82nd Congress Hearings on Fluoride revealed that there was no actual scientific basis for the fluoridation of water supplies in the prevention of tooth decay. The recommendation of the Committee was that more research be done, before proceeding with this national mass medication. Their recommendation was totally ignored.

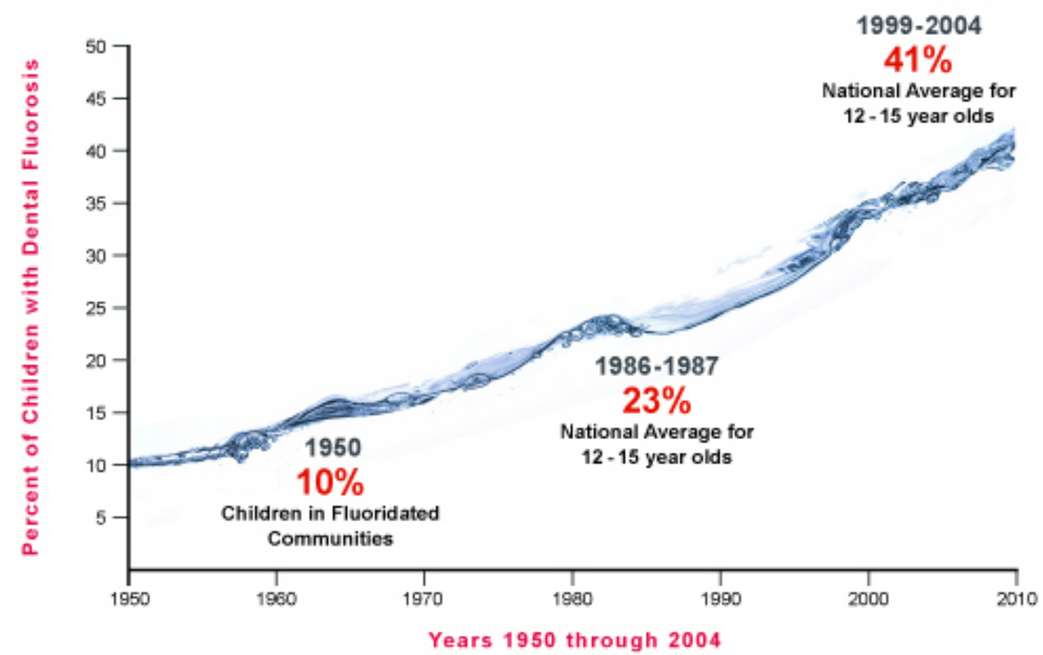
Blood Fluoride Levels in Preschool Children (ages 3 to 4) Compared to the Blood Fluoride Level that Impairs Glucose Metabolism in Adults*



*National Research Council. (2006). Fluoride in Drinking Water: A Scientific Review of EPA's Standards. National Academies Press, Washington D.C. p. 216.

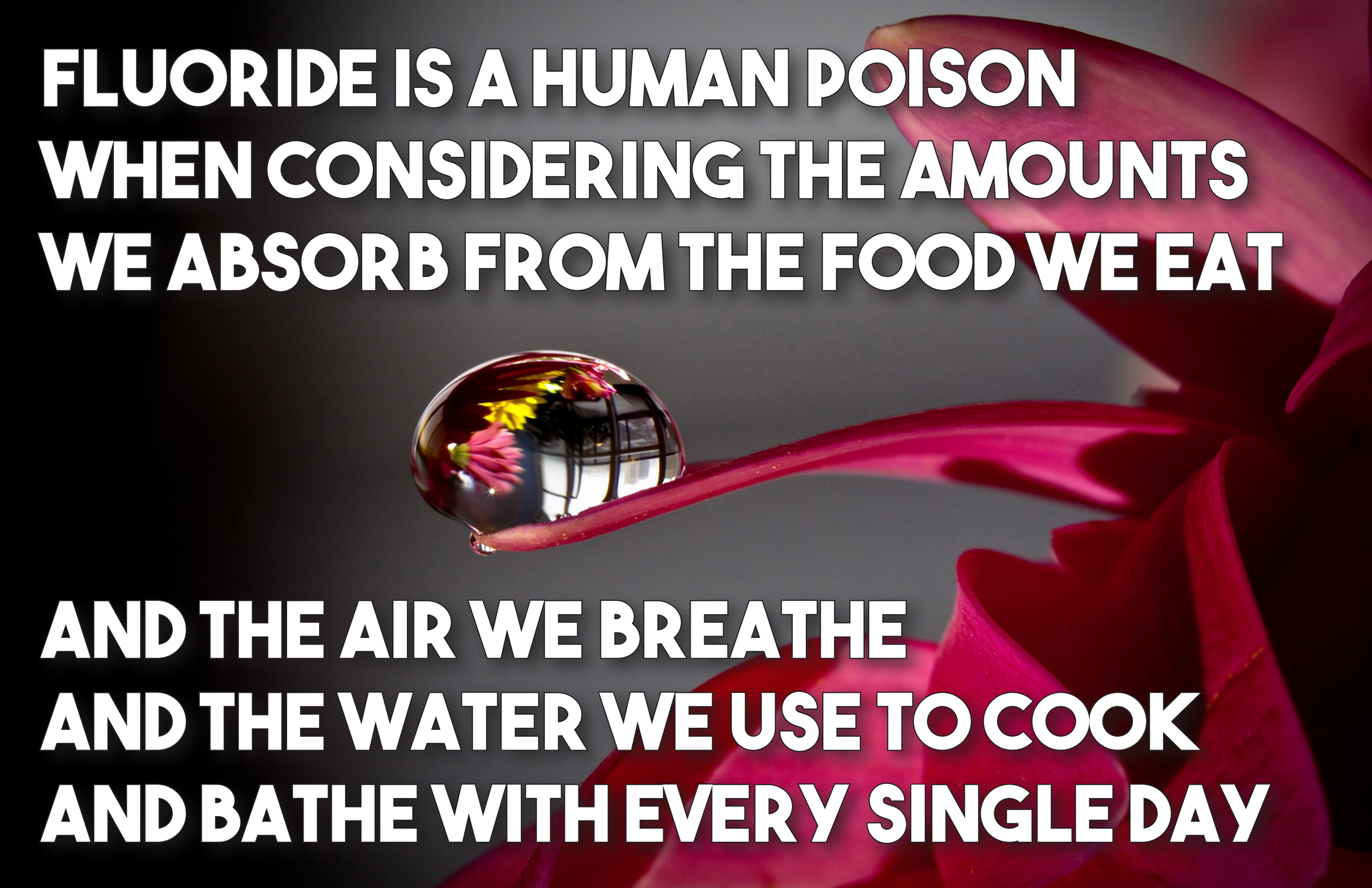
**Caries Research 1983, Volume 17, p. 380, Fig. 1; *Journal of Dentistry for Children* 1993, Volume 19, p. 122; *Journal of Public Health Dentistry* 1999, Volume 59, p. 217, Table 3.

Dental Fluorosis Rates in the United States: 1950 through 2004



Beltran ED, et al. (2010). Prevalence and Severity of Dental Fluorosis in the United States, 1999-2004. NCHS Data Brief No. 53. Figure 3.

National Research Council. (1993). Health Effects of Ingested Fluoride. National Academy Press, Washington DC. p. 4-5.


FLUORIDE IS A HUMAN POISON
WHEN CONSIDERING THE AMOUNTS
WE ABSORB FROM THE FOOD WE EAT
AND THE AIR WE BREATHE
AND THE WATER WE USE TO COOK
AND BATHE WITH EVERY SINGLE DAY

USDA

FDA

I'd like to thank the agencies represented here on this page for their non-contribution to American health

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

CENTERS FOR DISEASE CONTROL AND PREVENTION CDC

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